Works by the Author.

An Experimental Inquiry into the Laws of Life.

The Physiology of the Fœtus, Liver, and Spleen.

Inquiry into the Principles and Practice of Medicine, 2 vols.

The Philosophy of the Moving Powers of the Blood.

Diseases of the Lungs from Mechanical Causes.

Philosophy of Animated Nature, or the Laws and Action of the Nervous System.

The Discovery of the Use of the Hair in the Animal Economy.

PRACTICAL VIEWS

ON

NERVOUS DISEASES.

By G. CALVERT HOLLAND, M.D.,

LATELY PHYSICIAN TO THE SHEFFIELD GENERAL INFIRMARY, BACHELIER ES-LETTRES OF THE UNIVERSITY OF PARIS, FORMERLY PRESIDENT OF THE ROYAL PHYSICAL AND HUNTERIAN SOCIETIES, EDINBURGH.

> The character of the true philosopher is to hope all things not impossible, and to believe all things not unreasonable.
>
> J. F. W. HERSCHEL.

LONDON:
WILLIAM HEADLAND, 15, PRINCES STREET,
HANOVER SQUARE;
BAILLIERE, REGENT STREET; AND RENSHAW, STRAND.

MDCCCL.

ROCKEFELLER MEDICAL LIBRARY
INSTITUTE OF NEUROLOGY
THE NATIONAL HOSPITAL
QUEEN SQUARE, LONDON, WC1N 3BG
CLASS HIST N
ACCN. 6592
SOURCE recat
DATE May 1977

TO THE

Professors of the University of Edinburgh.

Gentlemen,

More than a quarter of a century has elapsed since my name was first inscribed on the books of your justly celebrated school, and I cannot look back to the period of my early studies, or recal the splendid opportunities for the acquisition of varied knowledge so amply furnished by the University of Edinburgh, without feelings of gratitude,—without an emotion which prompts these expressions.

One of my cherished wishes through life has been to dedicate the anxiously elaborated results of my physiological researches to you, as a trivial, but a sincere memorial of the lively impressions inspired by the remembrance of your learning, urbanity, and anxiety to impart information, as well as by the vivid recollection of the inestimable advantages offered by the numerous societies, medical, scientific, and literary, which, if not peculiar to, richly adorn your classic city. These deserve your warm encouragement. In the emulation they excite and the interest they awaken in the youthful breast, they co-operate in no mean degree in extending the usefulness and adding to the attractions of the Alma Mater. Permit me to present the fruits of these labours for your acceptance. "Would that they were worthier."

If in the course of the subsequent pages I have departed widely from any of the doctrines you inculcate; or if I have presumed to criticize opinions entertained by any of you, my apology is this: it is less the duty and the legitimate functions of your high office, to enforce particular views, than to stimulate and teach the mind to think. I trust, however, in the exercise of this privilege, that I have, in no instance, forgotten the courtesy and liberality which should ever distinguish the earnest inquirer after truth

Gentlemen,
Allow me to subscribe myself,
Your most obedient servant,
G. CALVERT HOLLAND.

London.
December 5*th*, 1849.

PREFACE.

The author has few remarks to offer in introducing the subsequent pages to the notice of the reader. Much that might with propriety have been stated in this place has been embodied incidentally in different parts of the work. The reasons which led to the composition of it are various; but one is especially predominant, viz., the strong conviction that the future progress of medicine will depend on the degree of attention devoted to the examination of the functions and influence of the nervous system. If the views which he has advanced be in the main justly founded, it will unhesitatingly be admitted that much remains to be accomplished in this interesting department of science. If he has succeeded in tracing the path of investigation,—in exhibiting the nature of the actions to be analyzed, and the mode in which they cooperate in the production of vital effects, or in illustrating in any degree the practical applications they suggest; or if, indeed, his merit extends no further than in exciting an interest in the study of this class of subjects, he has not altgether laboured in vain.

He is fully sensible of the force of the objection frequently urged against the exaggerated importance which a writer is apt to attach to his own exclusive pursuits. If his energies be concentrated to a limited or definite field of research, he unavoidably becomes enamoured of the objects he has long contemplated, and the feeling, as a necessary consequence, is prone to give an undue value to the results at which he arrives. This is unquestionably true. The ardour which carries him beyond the sober rules of philosophy, or the precision of strict logical deductions, is, nevertheless, a mental element which is almost essential to the discovery of truth in every branch of science. It is the spirit which prompts and animates the inquirer, which elevates his views, and imparts to them a charm and attraction they would otherwise not possess.

Truths in an advanced stage of development gain a ready and a permanent assent, though it may require ages to evolve their commanding attributes,—the inexhaustible resources with which they teem. The comprehension of such truths falls within the capacity of the many. But how limited is the number that can in any degree appreciate, at their just value, the initial thoughts or germs of principles! The shadows imperfectly cast before are discerned only by the few.

The author is aware that, in the subsequent researches, where he professes to open out new paths of inquiry, or to exhibit the application of acknowledged principles to the explanation of phenomena, previously altogether unaccounted for, (even where his efforts may have been successful) he has simply entered upon the threshold of the science of life. It will be for others, and the lengthened course of ages, to present larger and more accurate views; and he doubts not that the impulse given to the study of the laws of the animal economy, and its admitted importance, will at no distant date enrich us with results, compared with which, the light of the present century will afford a striking and humiliating contrast. This consideration, while it should teach a sober estimate of ourselves, should equally tend to remove the prejudices opposed to the introduction of what is new. Novel and speculative views are the natural consequences of the progress of knowledge, and our duty in relation to them, is to examine their pretensions with impartiality.

In the attempt to show that the nervous system is animated by a principle susceptible of accumulation and dispersion, and that according to the predominance of either condition, is the manifestation of vital phenomena, the author is sensible that he has laid himself open to objections. The doctrine has, nevertheless, been maintained by some of the highest authorities in physiology,—the soundest and most original thinkers. Concerning the nature of the principle, he does not presume to express a decided opinion, nor does the determination of the question at all affect his reasoning. Admitting its existence to be altogether assumed, if it accounts for a wide and diversified class of phenomena,—phenomena belonging equally to organic and animal life, which otherwise would be inexplicable, the assumption is not only legitimate, but is sanctioned by the example of the first writers of the age. One of these observes, "thus in the delicate and curious electro-dynamic theory of Ampere, the mutual attraction or repulsion of two magnets is referred to a more universal phenomenon, the mutual action of electric currents, according to a certain fundamental law. But in order to bring the case of a magnet within the range of this law, he is obliged to make a *supposition of a peculiar structure or mechanism, which constitutes a body a magnet, viz., that around each particle of the body, there shall be constantly circulating, in a certain stated direction, a small current of electric fluid.* This, we may say, is too complex; it is artificial, and cannot be granted: yet if the admission of this or any other structure tenfold more artificial and complicated will enable any one to present in a general point of view a great number of particular facts,—to make them a part of one system, and enable us to reason from the known to the unknown, and actually to *predict facts before trial,*—we would ask, why should it not be granted?"*

A peculiar structure in this case is *imagined* to exist,—a mechanism which does not admit of evidence, and yet such an assumption is regarded by the philosopher as perfectly legitimate. Were the physiologist to indulge in a similar liberty in the endeavour to bring certain actions of the animal system under a general law, which already included numerous others, he would subject himself to severe animadversions. The assumption is far less with respect to the existence of a nervous agent. Experiments of unquestionable authority establish beyond all doubt, that the contractions of the heart may be increased and subsequently diminished,—sensibility heightened or temporarily destroyed, by the concentrated energies of one individual directed towards certain parts of the body, of another, the two not being in actual contact. The writer has repeatedly produced these effects. Do they not indicate the exercise of some power, and, in the organs affected, a susceptibility of being influenced; and yet is it possible to conceive that these extraordinary modifications of vital action, are caused independently of a principle pervading the animal system?* If its existence be an hypothesis,—a figment of the mind, it is one which has strong claims on attention from the difficulties which it solves, and the light which it throws on the functions of life.

---

* A Preliminary Discourse on the Study of Natural Philosophy, by John Frederick William Herschel, Esq., A.M.

---

* The following remarks are from the same admirable philosopher, from whose writings we have already quoted; and the suggestion he offers in reference to the action of the heart, is valuable in two points of view: he sanctions by his high authority the attempt to explain vital phenomena on the assumed existence of a peculiar principle, and the mode in which he applies it accords generally with the doctrines we have laboured to establish. "If the brain be an electric pile, constantly in action, it may be conceived to discharge itself at regular intervals, when the tension of the electricity developed reaches a certain point, along the nerves which communicate with the heart, and thus to excite the pulsations of that organ. This

As regards future exertions, which the writer contemplates, in order to complete the comprehensive inquiry on which he has entered, he will briefly explain his intentions. He proposes, in the second volume,* to treat of the origin, nature and termination of nervous affections; to exhibit the relation of the symptoms to the disturbed nervous and circulatory conditions, and at the same time to study them in association with every altered vital action.

If it be imagined that the writer can see nothing of importance in the animal economy, save the operation of a nervous agent, his views of the principles of physiological science, of the powers of life, and of the causes by which they are affected, are most imperfectly appreciated. He has no such exclusive ideas. It would be unphilosophical to exclude from consideration, and from a due share in the combined influence exercised in the production of phenomena, any of the various portions of the living system. They all enter into the grand and intricate plan of organization, and it is the office of

---

idea is forcibly suggested by a view of that elegant apparatus, the dry pile of Deluc, in which the successive accumulations of electricity are carried off by a suspended ball, which is kept by the discharge in a state of regular pulsation for any length of time. We have witnessed the action of such a pile maintained in this way for whole years in the study of the above eminent philosopher."—*J. F. W. Herschel, opus cit., p.* 343.

* It was intended that the two volumes should have appeared together; but circumstances have, for the present, prevented the completion of the undertaking

the physiologist to ascertain the value of each,—the precise part which it plays in the general scheme.

On the correctness and largeness of the view taken of these mysteriously-linked actions, will depend the appropriate selection and employment of remedial measures. To see far into the frequently recurring derangements of the animal system, the mind must be familiar with numerous objects, which the study of the functions of life brings prominently under notice. Among these objects, especially claiming attention, are the moving powers of the blood, the causes by which they are disturbed,—causes equally modifying the properties of the vital current.

In the further proposed inquiry into the origin and nature of nervous diseases, the co-existing conditions of the circulatory system, as effects or causes in relation to them, will be elaborately analyzed. Hence let it not be urged, as an objection to these labours, that they are confined to a narrow field of investigation: that they bring under observation only a limited class of phenomena in connexion with morbid deviations. The writer has no such circumscribed notions of the duty which the undertaking imposes; and he trusts in a more liberal and just interpretation of the principles which have led to these researches.

CONTENTS.

CHAPTER I.

THE PROPERTIES AND FUNCTIONS OF THE NERVOUS SYSTEM.

SECTION I.—GENERAL REMARKS ON THE PROPERTIES AND FUNCTIONS OF THE NERVOUS SYSTEM.

PAGE
Progressive stages of discovery 34
Object and nature of the inquiry 37
Application of the views to the explanation of diseases 39
Prevailing opinions concerning the nervous fluid 40
Speculations of Müller on the action of the nervous fluid 41
Objections to the reasoning of Müller 42
Prochaska and Marshall Hall on the reflex action of the nerves 44
Views of Marshall Hall on the nervous energy 45
Circumstances which led to the present inquiry 46
Structural relations connecting all parts of the nervous system. 47
Nervous system pervaded by one common animating principle 48
Causes influencing the flow and action of the nervous energy 49

SECTION II.—THE NERVOUS SYSTEM IN ITS RELATIONS TO THE FUNCTIONS OF RESPIRATION.

Mechanism of respiration 51
Structure and functions of the lungs 52
Nervous relations of the lungs .... —
All vital operations intermittent—Exemplification. of the law in the action of the respiratory organs 53

PAGE
Nerves engaged in the process of respiration 53
Opinions of Bell and others..................................... 54
Cause of the simultaneous and harmonious action of the Respiratory system of nerves 56
Cause of the first inspiration 58
Explanation of the strong contractions of the uterus during labour 59
Relation of the nervous energy to the functions of the lungs 60
Causes disturbing the functions of the lungs 62

SECTION III.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE MOVING POWERS OF THE BLOOD.

Amount of existing knowledge on the functions of the Circulatory system.. 66
Action of the heart and its sources of nervous power 68
Cause of the successive contractions of the heart.—Remarks on the views of Haller and others 69
Objections to the experiment of Blumenbach in support of the doctrine of Haller 71
Opinion of Adelon on the cause of the contractions of the heart 72
Ingenious hypothesis of Müller to explain the intermittent action of the heart.. —
Objections to his views... —
Relation of the nerves to the arteries 75
Cause of gangrena senilis 76
Cause of the locally increased action of the arteries 78
Relation of the nerves to the capillaries 79
Conclusions flowing from the relation of the nerves to the Circulatory system 82

SECTION IV.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE DIGESTIVE FUNCTIONS.

An ample surface essential to the manifestation of extensive vital action 84
Two stages of activity of the digestive process 85
Sources whence the stomach derives its nervous power..................... 88
Vascularity of an organ the measure of its nervous power 90
Source and nature of the derangements of the digestive organs............ 91

SECTION V.—RELATIONS OF THE NERVOUS SYSTEM TO THE SECRETORY FUNCTIONS.

Movements of the heart, according to Professor Alison, independent of any action of the nerves 95
Vital principle or Vital affinities of physiologists 97
Analysis of the views of Professor Alison 98

PAGE
Influence of nerves in secretion 100
Opinions of Bostock, Blumenbach, Adelon, and Professor Alison on secretion 103
Analysis of the first objection of Professor Alison to the agency of the nerves in secretion 104
Animal and vegetable matter pervaded by the same common principle... 105
Analysis of the second objection urged by the same physiologist 108
Analysis of the third objection 111
Analysis of the fourth objection 114
No Experiment can be devised to arrest the flow of the nervous energy to any of the functions of organic life 116
Remarks on the nature of the objections to nervous agency 117
Analysis of the fifth objection .... —
Cultivation of every science the study of relations between objects...... 120
Two following objections advanced by Professor Alison against the galvanic theory of nervous action .... —
Power of exciting muscular contraction does not reside in nervous substance in general, but in particular parts of it 124
Nerves of *sensation* capable of conveying a galvanic current to the muscle, exciting it to contraction—Mechanical irritation of them fails to produce the same effect—Explanation of the phenomena... 125
Experiments in support of the views 126
Division or injury of a nerve regarded as not interrupting the transmission of the galvanic current 127
Experiment exposing the fallacy of the doctrine .... —
Division or injury of the nerves imagined by Professor Alison to affect secretion, by suspending the sensations of the part 129
Remarks on his opinion 130
Cause of the diseased conditions of the bladder on injury of the spinal cord 132
Cause of the structural changes of important organs on the division of the fifth nerve 134
Views of physiologists on the functions of the nerves 137
Influence of the mind on the quantity and quality of the secretions...... 140
Cause of the sudden emaciation of the body from mental depression... 142

SECTION VI.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE ORGANS OF GENERATION.

Mental and bodily changes in the female on the development of the organs of generation 145
Sympathies consequent on the awakened functions of the uterus, at puberty 149
Nervous affections antecedent to the aroused activity of the uterus...... 150
Sympathies produced by utero-gestation 152

PAGE
Organic changes during the progress of pregnancy 153
Mode in which the vital powers adapt themselves to new duties on the termination of uterine gestation 155
State of the vital powers after parturition 156
Remark of Cullen in corroboration of the views advanced 157
Influence of pregnancy in arresting pulmonary and other diseases...... 159
Organic changes in the male on the development of the organs of generation 161
Mental character and pursuits of the male at puberty 162
Influence of the generative system on the vocal organs...................... 164

SECTION VII.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE MUSCULAR APPARATUS.

Voluntary and involuntary muscles dependent on the same nervous agent 167
Sources of nervous power distributed to the voluntary muscles .... —
Sources of nervous energy distributed to the involuntary muscles 168
Distinction between the two classes of muscles in the nature of their action and in the expenditure of the nervous energy .... —
Sensibility is not a measure of the amount of nerves distributed to organs —
Manifestation of irritability dependent on a peculiar arrangement of the muscular fibre, and the presence of the nervous principle 169
Objections of Professor Alison to the dependence of irritability on the existence of nerves.. 171
Absence of the brain and spinal cord in the fœtus.—Conclusions drawn by the physiologist from the fact 174
Supposed objections to the nervous theory from the continuance of the involuntary motions of the organs of circulation after the removal of the brain and spinal cord 176
Imagined objections to the nervous theory, from the continuance of the contractions of *involuntary* muscles on the division of the nerves by which they are immediately supplied 178
Distinction between the nervous relations of *voluntary* and *involuntary* muscles .... —
Muscles of voluntary motion retain their irritability after the division of their nerves.—Supposed objection to the nervous theory......... 180
Nerves, according to the doctrine of Alison, do not furnish a condition in any way essential to the irritability and vital action of muscles in general 183
Cause of the difference in the results of mechanical and chemical agents applied to voluntary and involuntary muscles 184
Views of Alison on the uses of the nerves in relation to the muscles.. 188
Character of the physiological labours of Wilson Philip 189
His distinctions between the *Sensorial*, the *Nervous*, and the Muscular powers.. 190

PAGE
Nature of his arguments 191
According to Wilson Philip, nervous influence exhausts the excitability of the muscles 193
His experiments to determine the influence of the brain and spinal cord on voluntary and involuntary muscles 196
Misconception of the difference in the relations of the voluntary and involuntary muscles to the nervous centres 197
Explanation of the *regularity* in the contractions of the heart, and of the *irregular* convulsive movements of the voluntary muscles, in mechanical and chemical irritations of the brain and spinal cord 199
Character of the experiments of Wilson Philip to exhibit the exciting and *depressing* effects of the nervous influence—Fallacy involved in his conclusions 202
Value of the physiological labours of Dr. Marshall Hall 203
Similarity in the doctrines of Wilson Philip and Marshall Hall 204
According to Marshall Hall, the brain and the nerves of the senses are the seat of the ψυχη or the immortal soul, and are independent of the *Vis nervosa* 205
His views of the functions of the nervous system........ 206
His distinctions between the brain and the spinal cord in respect of the phenomenon of sleep.—His imperfect and limited views of the subject 208
Condition of the nervous system in sleep 209
Sense in which the brain can be imagined liable to sleep 212
Seat of emotion, according to Marshall Hall, is in the true spinal and the ganglionic systems 213
Objection to his reasoning .... —
Fanciful conjectures of Dr. Carpenter to explain the effects of emotion 216
Cause of the cessation of the irregular movements in chorea and in paralysis agitans, during sleep, and their return on the excitement of dreaming .... —
Objections which these phenomena present to the views of Marshall Hall 217
Explanation of the phenomena consequent on the exercise of volition in chorea and hemiplegia 219
Mode in which vision supplies the loss of the sense of touch in cases of anæsthesia 221
Nature of stammering.—Hypotheses on the subject 222
Methods of treatment and the grounds of their success 227
Influence of violent emotion on the vocal organs 228
Experiments of Müller, Nysten, and Legallois on the irritability of muscles 229
Views of Marshall Hall........ 230
His experiments with strychnine and galvanism on the sound and paralytic limb........ 231

PAGE
Remarks of Todd and Bowman on the excitability of paralyzed muscles 232
Distinction between the irritability and the susceptibility of muscles to contraction, as exhibited under the influence of emotion, strychnine and galvanism—Condition of the nervous system giving rise to the phenomena 233
Irritability proportionate to the vigorous conditions of the muscular organs 241
Cause of the paralytic limb usually first displaying the action of strychnine .... —
Emotion affects more readily the paralytic arm than the paralytic lower extremity.—Different results produced by the influence of strychnine.—Explanation of the phenomena .... —
Influence of yawning on the paralytic arm—Interesting case related by Dr. Abercrombie 243
Hypothesis of Marshall Hall on the effects of sleep on the irritability of the muscular system 245
Experiments of Todd and Bowman on the irritability of muscle 247
Objections suggested by an analysis of the experiments 248
Evolution of heat on muscular contraction 250
Experiments of Todd and Bowman on the successive contractions of each fibre of a muscle in action 251
Illustrations which the experiments furnish in support of the nervous theory 252
Causes of the different degrees of irritability possessed by different animals 253
Value of the facts derived from the consideration of hybernation 257
Tone of muscles 259
Effect of lightning on the animal system 261
Mesmeric phenomena, and their application to the elucidation of the nature of muscular irritability 262
Source and nature of nervous affections 264
All nervous diseases originate in disturbance of the nervous system...... 265
Discrepant opinions on the vital powers .... —
Diversity of medical treatment 266
Influence of the nervous system in inflammatory diseases 267

SECTION VIII.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE SKIN.

Structure of the skin 269
Discrepant views on the subject .... —
Labours of Todd and Bowman on the cutaneous tissues 270
Description of the epidermis 271
Rete mucosum 272
Description of the corium .... —

PAGE
Functions of the skin in their two-fold relations 274
Insensible perspiration regarded by Edwards as a purely physical effect 275
Objections to his reasoning 277
Views of Edwards on the copious perspirations occurring in the last moments of life 280
Production and absorption of gases by the skin.............................. 281
Nervous conditions of the skin 282
Causes modifying the influence of titillation on different parts of the body 283
Cases exhibiting changes in the sensibility of the skin.—Explanation of the phenomena 285
Relations of the brain to the cutaneous surface 288
Nature of the relations between the skin and the animal economy ...... —
Skin no peculiar relations to any part of the body 291
Explanation of the imagined intimate relations between the skin and kidneys 293
Relations of the skin to the internal organs 294
Nervous conditions of the skin in eruptive fevers .... —
Comprehensive and practical character of the investigations into the functions of the nervous system 296
Functions of the hair in the animal economy 298
Remarks of Bostock on the use of the hair.................................. 299
Modifications in the distribution of the hair .... —
Nervous and circulatory conditions of the skin in connexion with the hair 300
All organs, within certain limits, from the nature of their functions, or accompanying appendages, capable of relieving their temporarily disturbed actions 301
Function of the hair in relation to nervous organs.......................... —
Peculiar nervous conditions characterizing the spinal cord 302
Seat and action of the mental faculties in corroboration of the views... 303
Nervous conditions associated with the gradual decay of the hair from advancing years 304
Nervous and circulatory conditions at different periods of life 306
Cause of the persistence of the hair at the occiput.......................... 307
Effect of grief on the colour of the hair 309
Laws regulating the profusion of hair in different situations 311
Abundance of hair according to the concentration of nervous matter... 312
Quantity of hair proportionate to the existing vital actions 320
Cause of the difference in the distribution of the hair in the female and male 321
Changes in the nervous and circulatory systems, and their effects on the animal economy 325
Important modifications in the condition of the nervous system, in the female, on the cessation of menstruation 326

PAGE
Development and activity of the nervous system, in the female, in harmony with the general laws laid down 328
Supernumary organs, in the female, and their influence on the animal economy 329
Difference in the nature of the vital changes in the sexes after the prime of life 330
Cause of the less frequent baldness of the one sex than the other 333
Cause of the generally increased growth of hair on the face of the female after the change of life 334
Conditions modifying the appearance of hair on the face of the female 335
Facts in support of the views furnished by the eunuch ..... —
General application of the views 336

CHAPTER II.

THE LAWS AND NATURE OF SYMPATHETIC PHENOMENA.

SECTION I.—SYMPATHETIC PHENOMENA ORIGINATING IN A MODIFICATION OF CEREBRAL ACTION, INDEPENDENTLY OF IMMEDIATE EXTERNAL IMPRESSIONS.

Causes which have tended to retard the attainment of just views on sympathetic phenomena 340
Hypothesis on the causes of sympathetic phenomena 341
Remarks of distinguished authorities on the subject of sympathy 342
Condition essential to a knowledge of the source and nature of sympathy 343
Sensation, the cause of sympathy, as illustrated by Whytt ..... —
Instances of sympathetic action 345
Definition of sympathy ..... —
Influence of ideas on the expression of the countenance 346
Influence of ideas on the distribution of the nervous principle 347
Remarks of Alison on the causes of sympathy ..... —
Analysis of the doctrine of Alison 349
Changes in the distribution of the nervous principle and the consequent effects 350
Influence of ideas on the organs of generation 351
Ultimate facts in science 352
Influence of ideas on the respiratory system 353

PAGE
Somnambulism and night-mare illustrative of the influence of ideas on the motions of the body 354
Remarks of Bostock on night-mare.—Speculations concerning its cause 355
Exciting causes of night-mare 357
Condition of the mental faculties in association with somnambulism 358
Yawning, its origin and nature.—Conjectures of Fletcher..... 359
Yawning from sympathy.—Persons in whom it most readily occurs. 362
Influence of disease on the production of it..... 363
Changes in the condition of the brain giving rise to the phenomenon ... —
Causes influencing the production of sleep.—Phenomenon of snoring... 366
Phenomenon of sighing.—Explanation of Darwin..... 367
Remarks on the hypothesis of Darwin 368
Changes in the condition of the lungs characterizing sighing 370
Relations between the contractions of the heart and inspiration 371
Efficiency of inspiration as a moving power of the blood in the lungs... 372
Other considerations in favour of the hypotheses explaining the nature of sighing 373
Ideas and emotions affect the condition of the nervous principle at the cerebral extremity of the nerves 375
Sympathetic phenomena of coughing and sneezing,—Remarks of Alison —
Condition of the respiratory functions in coma.—Analysis of the views of Alison..... 377
Phenomena of blushing..... 379
Hypothesis of Marshall Hall on the cause of blushing 380
Objections to his views ..... —
Considerations which led to the hypothesis of Marshall Hall 382
Cause of blushing 383
Explanation of sudden pallor, and clammy, copious perspiration 384
Sympathetic phenomena of the digestive apparatus 385
Additional remarks on incubus or night-mare 387
Peculiar phenomena characterizing somnambulism 388

SECTION II.—SYMPATHETIC PHENOMENA ARISING FROM EXTERNAL IMPRESSIONS.

Examples of sympathetic phenomena from external impressions 390
Changes in the range of influence of organs exhibiting sympathetic actions..... 391
Sympathetic phenomena arising from external impressions studied in three different relations 392
Views of Whytt on *sensation* as a cause of sympathetic effects—Remarks of Alison..... 393
Distinctions between the two classes of nerves engaged in the production of sympathetic phenomena 394

PAGE
Views of Sir Charles Bell on the cause of the simultaneous action of nerves in respiration 395
Objections urged by Alison against these views 396
Consideration of the objections of Professor Alison 397
Phenomena of sneezing, coughing, speaking, and singing 398
Cause and nature of hiccup 399
Sensation considered in its relation to syncope 401
Sickness and vomiting occurring during utero-gestation and from the effects of medicinal agents 402
Cause of the depraved appetite in pregnancy 404
Nervous conditions associated with singing and speaking........ 405
Phenomena of sympathy manifested by organs in the ordinary exercise of their functions.—Contractions of the iris 406
Definition of sensibility.—Nature of its relations to the nervous system 407
Action of the iris in relation to the sensibility of the brain 409
Relations between consciousness and sensibility........ —
Influence of insensibility on reflex action 411
Sympathetic action between the two eyes.—Remarks of Mayo on the different nerves distributed to the muscles of the eye-ball........ 412
Explanation of the sympathetic action of these muscles 413
Remarks of Mayo on the voluntary contraction of the pupil 414
Sympathy between the abdominal muscle and rectum........ 416
Wide range of sympathies excited by parturition .... —
Influence of chloroform and ether in cases of labour 417
Consensual sympathetic actions of deglutition 418
Sympathetic affections arising from direct impressions on the organs of the senses .... —
Comprehensive character of vision.—Its extensive relations to cerebral matter........ 419
Modifications of ideas and feelings from changes in the distribution of the nervous principle........ 420
Condition of the nervous principle modified by the varying states of the mind........ 422
Sympathetic effects of grief.—Nature of the relief afforded by tears...... —
Hysterical and convulsive affections arising from impressions on the organs of sight 423
Sympathies excited by theatrical representations 424
Differences in the nature of the influence of real and simulated grief...... —
Circumstances adding intensity to the sympathetic effects of distressing occurrences........ 425
Sympathetic phenomena excited by the organ of hearing 426
Influence of music dependent on a peculiar cerebral organization 427
Dugald Stewart on the differences in the senses in relation to the association of ideas 428
Remarks upon his views .... —

PAGE
Dugald Stewart on the faculty of attention as manifested in sleep.—Objections to his conclusions 429
Sympathetic phenomena excited by the sense of smell 431
Sympathetic phenomena of the sense of taste 432

SECTION III.—ORGANIC SYMPATHETIC PHENOMENA.

Prevailing opinions on the nature of organic sympathy 433
Causes modifying the condition of the mammæ 434
Sympathy between the uterus and the mammæ of a mixed character 435
Objections to the views of writers on the nature of organic sympathy 436
Sympathetic relations between the gums and the intestines 437
Sympathetic relation between the stomach and the animal system generally 438
Nerves the media for the transmission of the influence of stimulants 439
Sympathetic relations between the mucous membrane and the muscular coat of the digestive organs 440
Sympathetic relations between the mucous membrane of the nose and mouth, and the disordered conditions of the alimentary canal 442
Variety of nervous affections arising from cold, wounds, and numerous sources of irritation, producing acute pain, locked jaw, and paralysis 444
Origin and nature of pain .... —
Sympathetic affections occasioned by derangement of the digestive organs 446
Nature of the nervous changes producing locked-jaw and tetanus 448
These diseases not dependent on inflammation 449
Sympathetic relations between the diseased states of the skin and the internal organs, and the numerous morbid effects to which it gives rise 452
Explanation of the phenomena 454
Operation of remedies applied to the skin 456
Hydropathic treatment.—The nature of its action 457
Organic sympathy in connexion with disease 459
Cause of the modified action of the heart in inflammation of the stomach or intestines .... —
Sympathetic phenomena consequent on inflammation of the lungs 461
Sympathetic phenomena excited by rheumatism.—Nervous condition in which it originates 462
Illustrations of organic sympathy from the intermittent character of vital action 463
Temperaments illustrative of organic sympathy .... —

CHAPTER III.

THE NATURE OF THE RELATIONS BETWEEN DISEASES ATTACKING THE SAME PERSON AT DIFFERENT AND OFTEN REMOTE PERIODS.

PAGE
Instances illustrative of the translation of disease 465
Views of Parry in explanation of the phenomena.—His doctrine of increased determination or momentum of blood 466
Organic conditions belonging to different periods of life .... —
Character of vital conditions of *external* and *internal* surfaces in infancy and childhood .... —
Vital conditions at puberty 467
Causes of the numerous nervous affections at puberty 468
Nervous conditions at an adult period of life, and their relations to various diseases 469
Phenomena of metastasis... 470
Relations of the solids and fluids to the nervous system 471
Nervous conditions on which metastasis of disease depends .... —
Differences of constitution in reference to its susceptibility of the metastasis of disease............................ 472
Views of Parry on the "increased determination or momentum of blood."—Causes modifying the distribution of the blood.... 473
Objections to the doctrine of Parry.. 474
Gout, a nervous affection 475
Cause of calcareous deposits in the joints.—Remarks of Mason Good... 476
Premonitory symptoms of gout .... —
Treatment of gout confirmatory of its nervous nature 478
Remarks of Mason Good on the variety of opinions concerning the nature of gout 479
Explanation of the tendency of gout to attack the ball of the great toe, toes, or fingers 480
Cause of the smaller joints becoming the seat of gout...................... 481
Nervous and circulatory conditions peculiar to the smaller joints ...... —
Conditions favouring the transmission of the same disease to successive generations.. 483
Cause of the occurrence of Nervous diseases at different periods of life 484

PAGE
Conditions of the nervous system predisposing to gout 485
Explanation of the frequent attack of gout at midnight, and of its remission 486
Circumstances establishing a wide distinction between inflammatory diseases and gout 488
Explanation of the difference in their progress and termination .... —
Influence of structure in modifying the action of gout, whether persistent or translated 489
Neglect of the study of physiology, and its consequences 491
Objections to the views of Parry 492
Opinion of Bichat on the influence of sensibility in the determination of blood 493

CHAPTER IV.

THE CONVERSION OF DISEASES.

Translation and conversion of diseases explicable on the same principles 494
Definition of the conversion of diseases 495
Reference to the labours of Hoffmann, Ferriar, Parry, and Prichard . . —
Interesting case related by the author..................... —
Every morbid action a centre of accumulated nervous energy............ 496
Practical importance of a knowledge of the nervous conditions on which metastasis of disease depends 497
All modifications of the circulation arise from the altered conditions of the nervous system 498
Explanation of the changes in the distribution of the blood, and their relations to disease .... —
Serious errors in practice from a misconception of the nature of the symptoms occurring in the translation or conversion of diseases... 501
Case illustrative of injudicious treatment 502
Cause of the frequent effusion of serum into the ventricles of the brain 504
Definition of inflammation and the conditions of the nervous system with which it is associated, and its important modifications from a difference in the structures in which it originates 506
Explanation of the absence of structural changes in cases of death from metastasis of disease to the nervous centres .... —

PAGE
Structural conditions of the different organs and the varying degrees in which they are modified by inflammation 508
Conditions of the brain and spinal cord in relation to the circulatory system, and the effects of inflammation................................ 510
Metastasis of gout to the brain, and the explanation of the absence of pathological appearances after death 512
Remarks of Prichard on the absence of structural changes 513
Membranes of the brain, and the causes of their frequent congestion... 514
Use of the ventricles of the brain... 515
Relation of these physiological researches to the study of metastasis of disease 517
Value of the blood and the recklessness with which it has been expended.. 518

CHAPTER V.

THE PRACTICAL DEDUCTIONS WHICH FLOW FROM PRECEDING INVESTIGATIONS, IN REFERENCE TO THE NATURE OF DISEASES GENERALLY, AND THE ACTION OF REMEDIES.

All truths abound in practical applications................................. 521
Value of nosological classifications 522
Remarks of Herschel on the classification of instances 523
Symptoms to be studied in their two-fold relations in reference to treatment 524
Conditions to be observed essential to the natural and efficient operation of remedies.. 525
Objections to the prevailing modes of treatment 526
Considerations of the dose and the mode of the exhibition of a remedy 527
Experiments establishing the potency of small doses of medicines ...... —
Practical inferences flowing from the facts stated 528
Consideration of the potency of minute doses of medicinal agents offers a vast field to the future inquirer 529
Nature of the object which the author has steadily kept in view in his investigations 530

CHAP. I.

THE PROPERTIES AND FUNCTIONS OF THE NERVOUS SYSTEM.

SECTION I.—GENERAL REMARKS ON THE PROPERTIES AND FUNCTIONS OF THE NERVOUS SYSTEM.

1. The inquiry on which we enter, whether studied in reference to the healthy or diseased conditions of the body, is of paramount importance. It has a direct application to both, and to the philosophy of the mind in its most comprehensive sense. It will elucidate a variety of nervous phenomena hitherto considered as among the mysteries of nature, a knowledge of the laws of which has an intimate and practical relation to the wide field of medical science. This can be improved only by the steady cultivation of physiology; and of the numerous objects which it presents to the enlightened understanding, the nervous system, in whatever point of view it is regarded, has the first claim on our attention.

II. Every department of science has its progressive stages of development, in each of which facts assume a new and a higher value in proportion to the largeness of the principles with which they are associated. In the effort to establish these, how various occasionally are the sources whence the materials are derived, and how slight appear the affinities by which these are linked, until accident, occurring to the intellect fully prepared to take advantage of it, or profound reflection, strikes out some general law by which the different elements are grouped into one beautiful whole! Such is the origin of the most splendid achievements in science. It teems with illustrations; some of the most familiar being the law of gravitation, the polarization of light by reflection, electro-magnetism, the atomic theory, the circulation of the blood, and the doctrine of phrenology; to which may now be added, not inferior to any of these in its comprehensive and practical bearings, is the theory of nervous action, resulting from the contemplation of mesmeric phenomena.

III. It is far from our wish to underrate the labours of others in this inexhaustible pursuit. The truths they have established, or the new vistas of thought which they open, were necessary steps towards the evolution of more extensive views and juster modes of reasoning. It is no reflection on their genius, nor do their errors require any apology, that succeeding inquirers attain a higher point of observation whence they are enabled to survey, with a finer power of analysis, a greater number of facts, in relations, also, in which they were previously not studied. The contributions of one age or generation inevitably become the foundation on which another builds.

IV. In connexion with this investigation it would be ungrateful not to record the names of Haller, Whytt, Prochaska, Bonnet, Gall, Müller, Walker, and Bell. Among these, however, there is one that stands prominently out and will in all ages—the Newton of physiology—the illustrious Gall. The laws of cerebral organization which he developed will give an impulse to thought, the tendencies and effects of which none can adequately appreciate. The vastness of his views is equalled only by their simplicity.

V. It is interesting to observe how the progress of one branch of science tends to accelerate that of others; and further, to trace the evidence which the reflected light yields in confirmation of truths to which at first they seemed to have no kindred relation. Science does not present a more striking or apposite illustration of the justness of this remark, than the direct support which mesmerism gives to the principles of phrenology. These alone, if such an illustration be allowed, may be regarded, in reference to the constitution of the mind, as an exquisitely formed instrument, the keys and strings of which are obviously adjusted to the production of a variety of phenomena; and yet how difficult it would be, from the mere contemplation of the physical conditions, to believe in its capabilities or diversified powers. The mesmeric touch at once reveals, with unerring truthfulness, the impulses of thought and feeling in harmony with the excited faculties.

The phrenologist will, perhaps, object to the implied necessity of such reflected light, contending, and justly, that the conduct and intellectual capacities of men are in strict accordance with their cerebral development, which admits of an admeasurement sufficiently accurate for all practical purposes. But the results which flow through the medium of mesmerism, are as conclusive of the natural functions of the individual faculties as are the tones drawn out from an instrument of its separate and variously-strung chords. When we consider the wild and discrepant views which have been entertained in all ages on the number, character, and operations of the mental powers, and contemplate the marvellous insight which mesmerism gives of the constitution of the human mind, it may be asserted, without reservation, that the phenomena which it presents have a value, beauty, and sublimity equal to the noblest achievements of science.

Scepticism may refuse to receive the evidence on which they rest, but it can only be for a time. It may as reasonably doubt the ability of the chemist to solve compound substances into their several elements, or question the accuracy of the astronomer in recording the laws which explain the motions of the planetary systems. To withhold an assent from the truths which this influence establishes, is to endow the phenomena which it evolves with a higher degree of mystery and marvel than they already possess. If each organ responds in its instinctive language to the mesmeric touch, it will scarcely be denied that it has a particular locality, or that it may be aroused to activity by external agency.

VI. Our business, however, on the present occasion, is not the consideration of the mental faculties, but the existence and action of a principle which may be designated nervous from its obvious relations to the nervous system. If it can be shown, which has already been done,* that it pervades the entire animal frame, is the cause, too, of all vital phenomena, and of the endless variety of their modifications; will not the undertaking be allowed to be one of commanding interest, both in regard to the vital actions in health and the diseases arising from their disturbance, the origin and nature of which are involved in doubt, whilst for their treatment there are no general or fixed principles of practice?

If the investigations do not impart additional light, they will not thicken the darkness which invests the subject. An independent exercise of thought is invariably fraught with good. It may err in the deductions which it draws, but the path in which it travels, whether direct or circuitous, opens out new points of interest, enlarges the field of observation, and facilitates the efforts of subsequent labourers.

---

* The Philosophy of animated Nature, or the Laws and action of the Nervous System. John Churchill, Publisher, Princes Street, Soho, London, 1848.

The proposed theory of nervous action is not a hasty generalization: it is the result of years of reflection. If it rest on no solid foundation, we may say, with slight verbal alterations, in the words of a distinguished writer, "It is at least the most curiously artificial system that science has yet witnessed; and whether it be so or not, so long as it serves to group together in one comprehensive point of view a mass of facts almost infinite in number and variety, to reason from one to another, and to establish analogies and relations between them; on whatever hypothesis it may be founded, or whatever arbitrary assumptions it may make respecting structures and modes of action, it can never be regarded as other than a most real and important accession to our knowledge." *

VII. In a previous work it has been shown, that the phenomena of mesmerism are to be traced to changes in the distribution of the nervous fluid, the evidence there adduced proving the existence of an agent susceptible of accumulation and dispersion; and further, that a knowledge of the laws by which its action is regulated, accounts for an immense number of mental and vital conditions which have hitherto been considered as inexplicable.

---

* A Preliminary discourse on the study of Natural Philosophy, by John Frederick William Herschel, Esq., A.M., p. 262.

It is now our intention to exhibit the application of the same views to the solution of other difficulties, and particularly in connexion with the origin, nature, and treatment of several extensive classes of diseases. To do justice to this part of the inquiry, it will be necessary to enter somewhat at length into an analysis of the functions of the nervous system, and to show that these can be explained only on the principles which have resulted from our individual investigations. If they break down in this attempt, or, in other words, if they fail to carry conviction of their soundness to the philosophical mind, it will be in vain, by any ingenuity or sophistry, to urge that they, nevertheless, throw light on a variety of morbid conditions. There cannot be one order of comprehensive principles applicable to the natural phenomena of life, and another, irrespective of them, having a reference only to their deviations from health. If they are not equal to the exigencies of both they are undeserving of notice.

VIII. In using the term nervous fluid it must clearly be understood that no opinion is expressed concerning its nature. The speculations to which it may give rise have no necessary bearing on the scope of these inquiries. That it is a principle admitting of accumulation and dispersion, and that vital action is modified according to these conditions, is a fact as well established as any in the wide range of physical science.

IX. In analysing the prevailing views on the functions of the nervous system, the first step is to ascertain to what extent they have elucidated the nature of nervous and other diseases, and how far they have influenced the suggestion and application of remedies. If it can be shown, which will be easy of demonstration, that they have scarcely been felt in either of these directions, the necessity for further researches will not be doubted.

X. Few of the modern physiologists acknowledge a pervading fluid in the nervous system, and none attempt to account for any of the phenomena of life on its susceptibility of local increase or diminution.

Bostock remarks that "the doctrine of the animal spirits has likewise become a subject of popular belief, and has given rise to a variety of expressions that are every day employed in our common language. There does not, however, appear to be the least shadow of proof of their existence, either from experiment or observation; there is no analogy in their favour, the structure and physical properties of the nerves do not seem adapted to the office that has been assigned them; and, in short, the whole is an hypothesis entirely unfounded and quite gratuitous."* The same writer, in alluding to Blumenbach, who advocated the doctrine of a nervous fluid, and whose excellent work on physiology has been translated by Dr. Elliotson, compliments the latter on his judgment in rejecting such an hypothesis and the deductions which are drawn from it.

---

* An Elementary system of Physiology, Third edition, by John Bostock, M.D., p. 146.

XI. There are, however, eminent physiological authorities in favour of the existence of a nervous principle, as Reil, Humboldt, Aldini, Cuvier, Beclard, Rolando, and Wilson Philip. The two last-named have laboured to establish the identity of the nervous and electric fluid. Wilson Philip has endeavoured to prove that some of the important processes of life may, on the interruption of the nervous energy, be efficiently carried on by galvanism. Müller contends that the two have very dissimilar properties. We have elsewhere* exposed the fallacy of the conclusions drawn from his elaborate investigations. In speaking of these principles he says, "Are their effects produced by currents of an imponderable matter travelling through space, *or by the undulations of a fluid?* Which theory be correct in the case of the nervous principle, is at present a *matter not affecting the study of the laws of its action.*"† In another part of his work he observes, "that the action of the nervous principle may be explained by either of these theories." ‡ The same opinion is also entertained by others, and is urged to show the inutility of researches to determine the question. There is, nevertheless, a wide distinction between the two doctrines in reference to the laws of nervous action, and it is remarkable that it has not been perceived. In the operations of the special nerves of sense, it might be imagined from particular facts that the phenomena were explicable on the undulatory theory. A more extended knowledge will, however, show that this cannot possibly account for the variety of changes occurring in the nervous system.

---

* Philosophy of animated Nature, &c.

† Elements of Physiology, by J. Müller, M.D., Translated by William Baly, M.D., p. 640.

‡ Ibid., p. 670.

Mesmerism enables us to accelerate and invigorate the contractions of the heart, to bring most powerfully into play the mental faculties and the muscular system, and, with the same ease to allay the inordinate actions induced. These, and numerous other phenomena, cannot be satisfactorily explained, except on the supposition that the nervous energy may be accumulated or dispersed.

According to the undulating theory, it cannot be conceived to be subject to these conditions. If it can be increased so as to treble the action of an organ, we are bound in strict philosophical reasoning to acknowledge, that the agent, whatever be its nature, is susceptible of the modifications which are here insisted upon. There is one species of evidence which is quite conclusive on this point. The actions of various parts of the body, as the heart, the brain, the intestines, and the muscular system, can be excited by mesmerism without any actual contact between the operator and the organs influenced. What becomes of the undulatory hypothesis in this case? Will it be argued that the undulations are transmitted through the air as along the nerves? If so, the nervous fluid has no necessary connexion with nervous matter.

XII. Why the structure and physical properties of the nerves do not adapt them for the reception and transmission of it we have yet to learn. The argument pre-supposes a knowledge of the required conditions. Why are not these stated to set at rest all speculations on the subject? The nerves convey a something which excites voluntary and involuntary muscular contractions; and, therefore, the proper course to pursue is, not to predetermine the conditions indispensable to the transmission of it, but, by an elaborate analysis of its operations, to endeavour to discover whether facts give any weight to the idea that a principle exists. To attempt to elucidate the functions of the nervous system, independently of a fluid which may be variously modified in its distribution, is not less absurd than it would be to expatiate on the influence of the circulatory apparatus, without taking into account the changes in the qualities and motion of the blood.

XIII. None of the distinguished authorities who advocate the necessity of a fluid to explain nervous phenomena, have laid down any general principles in reference to it. Their experiments and arguments mainly go to establish the fact. The laws by which it is regulated, or the causes by which it is disturbed, have not entered prominently into their views, or been brought within the range of their researches.

XIV. Dr. Marshall Hall has written largely on the nervous system, but it may be shown that his views furnish no objection to the force of these general remarks. To Prochaska is due the merit of having directed attention to what is designated the *reflex* action of the nerves. His successor, in the cultivation of the same interesting department of inquiry, has applied the principle to the explanation of a greater number of phenomena, but has clearly had no just conception of their origin, or the causes modifying their production; nor has he, indeed, *drawn any important practical conclusions from the principles tending to elucidate the nature and treatment of nervous diseases.* He endeavours to expose what he conceives to be fallacies in the application of the doctrine by Prochaska, but in this he decidedly fails. His own errors are evidence how little he understood of its comprehensive relations to the nervous system. Prochaska shows that the motion of the heart and of the intestines, and other phenomena somewhat similar in character, are to be traced to a *reflex* action of the nerves in connexion with the particular organs—an inference which is ridiculed by Marshall Hall. He says, "it is impossible to argue with persons of such confusion of ideas." We have shown, at considerable length,* and shall further illustrate the subject in the course of this investigation, that all vital functions dependent upon or manifesting contractility, are necessarily maintained by reflex action; or, in other words, the nerves belonging to their respective organs draw from the great nervous sources the principle essential to the continuance of their operations. If these nerves did not stimulate or in some mode affect these sources, the current which they furnish would not flow in the required directions. *It is on this view that all reflex phenomena are explicable.*

---

* Philosophy of animated Nature, chap. viii., sec. 3.

We shall further exhibit his limited notions of nervous phenomena. In his explanation of them he employs the *vis nervosa* of Haller, which he says, is "*the principle of action* in the entire spinal system;" and he remarks that he is "*inclined* to believe that the *same* principle of action, the same *vis nervosa,* exerts its power in the ganglionic system."* According to his ideas the *vis nervosa* has no connexion with the cerebral organs. He observes, that "the principle of action, in the cerebral system, is the ψυχη, or the immortal *soul.*" It is, therefore, evident that the nervous energy, whatever it may be, has in his hands only a partial application. It exists in the spinal cord and is brought into play "in all the acts of ingestion and egestion;" and he is *inclined* to believe that it exerts its power in the ganglionic system, but has nothing to do with the functions of the brain. His views certainly cannot be adduced as evidence of a comprehensive and philosophical understanding. They are scarcely more worthy of notice than would be the results of investigation concerning the functions of the circulatory system, which confined the attention to the arteries and the capillaries, asserting, that the contractions of the heart were excited by an agent very different from that which operated in these vessels, and, consequently were to be treated altogether on different grounds.

---

* On the diseases and derangements of the Nervous System, by Marshall Hall, M.D., F.R.S., p. 5.

XV. The circumstances which first led us to the prosecution of this inquiry, or, at least, imparted an interest to it which was previously not felt, originated in observing the changes in the sensibility and muscular motions of the body resulting from the application of mesmerism. It was not possible to contemplate the increase in the acuteness of the former to external impressions, or its sudden and entire temporary destruction, or the greatly augmented power which was acquired by the muscular system, without having the mind awakened to the consideration of the phenomena. The study of them seemed inevitably to lead to one conclusion, viz., the existence of a principle which may be so modified as to give rise to these conditions. Sensibility must depend on a certain state of the nerves, and, therefore, if we have the power of augmenting or abolishing it at pleasure, either with or without the contact of the operator, it is difficult to avoid the inference, that the effect is to be ascribed to changes in the distribution of the nervous fluid. The same argument, also, applies to the temporary increase of muscular strength. That this may be induced to a degree far exceeding what is natural, and that it may be instantaneously destroyed, are facts which cannot be questioned; so, with as little propriety the doctrine on which they are expounded.

XVI. It is not necessary to enter minutely into a description of the nervous system, to convey to others a just and enlarged conception of the laws by which its operations are governed. The phenomena to which it gives rise are various, but the principles on which they are explained, whether occurring in health or disease, may be brought within the capacity of the ordinary understanding. The simplicity of a theory, which is at once comprehensive and practical, is strongly in favour of its truthfulness.

The brain—the spinal cord—the special nerves of sense—the cerebral nerves and the nerves of the ganglionic system, which belong especially to the internal viscera, are all connected with each other and are parts of a grand scheme of organization. The variety of their functions depend on the structure of the organs which exercise them. The brain is the seat of thought and feeling, and all the modifications in the number and character of its faculties, are the result of certain definite laws impressed upon organized matter. The five senses, from their structural relations to an external and internal apparatus, perform their mysterious offices. The spinal cord is the connecting medium between the brain and the rest of the animal system, and its function is to furnish, at slight intervals, along its whole length, nerves of sensation and of motion to the viscera, the limbs and various tissues. The cerebral nerves, or the nerves arising from the base of the brain, impart, also, the properties of sensibility or of motion to the parts to which they are distributed. The ganglionic system of nerves, or the great sympathetic, which traverses the entire internal surface of the spine, occupies a position which brings it in connexion with the spinal and certain cerebral nerves, and is, likewise, peculiarly favourable for forming in combination with them, numerous little centres of nervous power, such as plexus and ganglia, from which each internal organ is supplied directly with the agent essential to its action. Such is, in few words, the scheme of the nervous system. Its simplicity and grandeur—qualities not incompatible—will be more evident as we proceed. One principle pervades the whole nervous system, and is the immediate cause of the variety of phenomena which fall under observation. The mode in which it is brought into operation opens up a field of inquiry of deep interest and importance. In its practical value it is second to no discovery in science.

The numerous organs of the animal economy, though excited and maintained in action by the same common agent, are constantly varying in the demands which they make upon it. The brain is the great source of it; the direction in which it is transmitted is regulated solely by the vital operations which call it into play. Whether these be continually, or only periodically in exercise, every modification in them is accompanied with a corresponding change in the strength of the nervous current. In fact, all the phenomena of life may be shown to be explicable on what is designated *reflex* action.

XVII. We have alluded to the different nerves which are either directly or indirectly connected with the brain and spinal cord, and which are the media of communication between these organs and every part of the animal system. They are the carriers and distributors of the nervous fluid. If sight and hearing are powerfully excited, it will flow in increased quantity towards these senses. If the stomach, the heart, the kidneys, or the intestines are aroused to inordinate duties, it will take the direction of these organs according to their increased necessities. If the limbs are brought into vigorous play, the supply will be in harmony with the demand. If the mental faculties are occupied with deep or intense thought, or are disturbed by the violence of passion, it will furnish a stream agreeably to their requirements. Whatever be the nature of the vital action, or wherever situated, it will draw from the nervous sources an amount equal to its temporary wants.

This exposition, if clearly understood, will show that the general law, here laid down in reference to the operations of the nervous system, is of immense application. The study of it will display, in a light which cannot be mistaken, the conditions which are essential to health, and the mode in which they are limbs and various tissues. The cerebral nerves, or the nerves arising from the base of the brain, impart, also, the properties of sensibility or of motion to the parts to which they are distributed. The ganglionic system of nerves, or the great sympathetic, which traverses the entire internal surface of the spine, occupies a position which brings it in connexion with the spinal and certain cerebral nerves, and is, likewise, peculiarly favourable for forming in combination with them, numerous little centres of nervous power, such as plexus and ganglia, from which each internal organ is supplied directly with the agent essential to its action. Such is, in few words, the scheme of the nervous system. Its simplicity and grandeur—qualities not incompatible—will be more evident as we proceed. One principle pervades the whole nervous system, and is the immediate cause of the variety of phenomena which fall under observation. The mode in which it is brought into operation opens up a field of inquiry of deep interest and importance. In its practical value it is second to no discovery in science.

The numerous organs of the animal economy, though excited and maintained in action by the same common agent, are constantly varying in the demands which they make upon it. The brain is the great source of it; the direction in which it is transmitted is regulated solely by the vital operations which call it into play. Whether these be continually, or only periodically in exercise, every modification in them is accompanied with a corresponding change in the strength of the nervous current. In fact, all the phenomena of life may be shown to be explicable on what is designated *reflex* action.

XVII. We have alluded to the different nerves which are either directly or indirectly connected with the brain and spinal cord, and which are the media of communication between these organs and every part of the animal system. They are the carriers and distributors of the nervous fluid. If sight and hearing are powerfully excited, it will flow in increased quantity towards these senses. If the stomach, the heart, the kidneys, or the intestines are aroused to inordinate duties, it will take the direction of these organs according to their increased necessities. If the limbs are brought into vigorous play, the supply will be in harmony with the demand. If the mental faculties are occupied with deep or intense thought, or are disturbed by the violence of passion, it will furnish a stream agreeably to their requirements. Whatever be the nature of the vital action, or wherever situated, it will draw from the nervous sources an amount equal to its temporary wants.

This exposition, if clearly understood, will show that the general law, here laid down in reference to the operations of the nervous system, is of immense application. The study of it will display, in a light which cannot be mistaken, the conditions which are essential to health, and the mode in which they are frequently deranged. It will also enable us to trace the manner in which disease, whatever be its character, disturbs, deteriorates, or destroys the powers of life. There cannot be a centre of morbid activity without the nervous fluid flowing towards it, according to the severity of the symptoms; and such will be the measure of the loss to the rest of the animal economy. The contemplation of this law will not only instruct us concerning the origin, nature, and influence of various maladies, but will enable us to attain to more just, simple, and comprehensive views of practice. The further consideration of it, in connexion with the individual systems of the body, or a series of organs co-operating in the exercise of one general function, will afford additional and copious illustrations of its truth.

SECTION II.—THE NERVOUS SYSTEM IN ITS RELATIONS TO THE FUNCTIONS OF RESPIRATION.

XVIII. It has already been remarked that the object of these inquiries is not to furnish a minute description of the nervous system, or of the organic instruments with which it is associated; but to present such a view as may be necessary to elucidate the laws of nervous action. Were we to depart in any instance from the broad outline by which the subsequent investigations will be regulated, it would certainly be in reference to the respiratory functions. Their importance in relation to the vital powers generally, and to the numerous organs which they arouse, in the expression of mental emotions and other acts, would be a reason sufficiently valid.

XIX. In the excitement of passion, the whole frame is animated, and especially through the influence of the respiratory system of nerves. The muscles of the chest and of the trunk are thrown into convulsive movements, as well as those of the face and of the limbs. The lungs, the trachea, the diaphragm, and the heart are similarly influenced. The variety of the effects have led to numerous elaborate inquiries concerning the particular nerves engaged in the production of them. The general results arrived at will be sufficient to illustrate our views.

XX. The mechanism of respiration is for the purpose of aerating the blood in the lungs, and this is accomplished by inspiration and expiration. By the former, fresh air is received from without; and by the latter, that which has lost its vital qualities is expelled from within. These two acts are susceptible of great changes. They are modified by all strong emotions and by all diseases of a serious character. At one time they are increased both in number and in amplitude of function; at another they are slower, or may be accelerated with a diminution of their efficiency. All these diversities are necessarily connected with corresponding alterations in the capacity of the chest. The mode in which this is augmented is by flattening the arch of the diaphragm, which divides the thoracic and abdominal cavities, and by the elevation of the ribs through the intercostal muscles. In a forced or exceedingly full inspiration, the muscles of the breast, shoulders and other parts, co-operate in enlarging the space for the play of the lungs, and, as an inevitable result, are instrumental in imparting additional vital properties to the blood. The lessening of this capacity in all cases of disease,—save in purely inflammatory affections, is always accompanied with diminished chemical changes.

XXI. The structure of the lungs is beautifully adapted to the office which they have to perform. They consist of minute vesicles or cells, into each of which the air is brought through the fine divisions of the bronchial tubes to act upon the blood which is conveyed to them. As nervous energy is unquestionably associated with every vital action, and is shown to be transmitted by innumerable nerves throughout the entire ramifications of the arterial system, it can scarcely be doubted that these vesicles are supplied with it, and, in virtue of it, are enabled to perform their peculiar and important functions, one of which is contractility, which regulates the admission and expulsion of air. The consideration of this property has given rise to lengthened discussions and various speculations. The weight of evidence, however, is decidedly in favour of its existence and influence.

XXII. The lungs, in common with the rest of the internal organs, are copiously furnished with the nervous principle from certain cerebral, ganglionic, and spinal nerves; and, as already remarked, these are only channels for the transmission of it, and though they may connect the breathing apparatus apparently with different nervous centres, the animating power is probably derived from one source only —the brain. We have endeavoured to prove that the course and strength of the current, in which it flows, are determined exclusively by the nature and seat of the particular vital actions. The lungs are no exception to this law. The more excited their functions the greater will be the stream of nervous energy drawn towards them; and, if such condition be induced, by disease, it may be one and the chief cause which occasionally promotes the rapid exhaustion of the energies of life.

We have elsewhere * established another law not less universal in its application, viz., THAT ALL VITAL OPERATIONS ARE INTERMITTENT, the pause being essential for the supply of the nervous fluid expended in the previous moment of exertion. The study of a variety of vital phenomena confirms this interesting fact. It may be traced in inspiration and expiration. The latter furnishes an interval of repose (the diaphragm and the parietes of the chest returning by their elasticity to a state of rest), during which the fluid accumulates to be again wasted; and it is

---

* Philosophy of animated Nature, or the Laws and action of the Nervous System.

thus that a successive series of acts, displayed in all the voluntary and involuntary functions of the animal system, are maintained in healthy or vigorous play. Do we not observe the same law in the contraction and dilatation of the air-cells constituting the structure of the lungs? And is it in these less indispensable?

The nervous principle may be necessary, not only to their action, but to the chemical changes of the blood; in the same way as it excites the muscular movements of the stomach, and the secretion of the juices by which digestion is effected.

There is the same provision in the contractility and dilatation of the vesicles for securing the nervous current, as exists in every organ in which the law of intermittence is observed. It would be illogical to imagine an exception to a rule which is found to prevail throughout the important functions of life. The contemplation of it, in this instance, is interesting, not simply as affording additional evidence in confirmation of a theory, but from the practical value with which it is fraught. The knowledge of it and of the causes by which it is disturbed, will suggest a rational explanation of numerous diseases, the nature of which is scarcely at all understood.

XXIII. Anatomists have satisfactorily ascertained the various nerves engaged in the natural and excited movements of respiration. In the latter condition the muscles of the face, chest, and trunk are simultaneously brought into action. The facial nerve gives expression to the countenance; two branches of the nervus vagus regulate the dilatation and contraction of the glottis; the lateral enlargement of the thorax, during inspiration, is effected by the spinal nerves and the nervus accessorius Willisii; the contraction of the diaphragm in inspiration depends on the phrenic nerve; and, lastly, the action of the abdominal muscles during expiration is to be traced to the agency of the spinal nerves.*

The nervous power distributed to the organs of respiration, as well as to all other parts of the body, is derived from two different classes of nerves—*those which are essential to motion, and those which impart sensibility.* It is to the former only that our present observations refer. How diversified soever the phenomena which the respiratory system of nerves brings into view, they are far easier to explain than is generally imagined. It was supposed by Bell, "that a *special set of fibres* in the medulla oblongata and spinal cord is the source of the influence which gives rise to the SIMULTANEOUS *and* HARMONIOUS *action of the respiratory nerves of both kinds.*" † Other physiologists have also laboured to prove that special fibres, altogether independent of the ordinary motory and sensitive nerves, have peculiar and extensive duties which these could not possibly perform. Such speculations indicate a limited acquaintance with the laws of nervous action. It would be as rational to argue that the capillaries of the kidneys or of any of the internal organs, furnishing a particular secretion, receive blood from a source very different from those which minister to the mental functions. Nature does not act in this manner: her operations are governed by general not by partial laws. There is only one nervous fluid pervading the entire animal system, and there is no necessity for special nerves to convey it. Wherever it produces motion, it flows through the same general channels and is regulated in its distribution and influence by the same general conditions.

---

* Müller opus, cit. p. 348.

† Müller, p. 350.

The simultaneous and harmonious action of the respiratory nerves, does not require for its explanation a peculiar class of nervous fibres. All nerves can be affected in two modes only: first, *in their peripheral extremities, whether they be nerves of sense, of motion, or of sensibility; and, secondly, in the nervous centres whence they originate, or in which they terminate.*

The spinal nerves arise from the spinal cord, but according to the views previously developed, those of motion are to be regarded as having their origin in the *medulla oblongata,* and those of sensation in that part of the brain which takes cognizance of impressions. Though connected with the cord, this is only *the medium for the transmission of the nervous principle in two different directions.* If the motory nerves are stimulated at the point whence they arise, as in all emotions exciting a variety of muscular actions, these will vary in extent and character according to the nature and strength of the feelings by which they are produced. There is no difference in the mode of their operation whether they illumine the countenance with a smile, or throw the muscular system generally into convulsions—*save in the energy of the particular exciting causes.* To seek for special fibres in any of these cases, in consequence of a diversity of phenomena being associated in the expression of passion, would be in the highest degree unphilosophical.

XXIV. *The simultaneous and harmonious action of the respiratory system of nerves,* necessarily results from the circumstance of these having the same common origin in the sense in which this has been explained. The terrific muscular effects excited by galvanism on the dead body, is a striking illustration of the fact. These are certainly far greater and more varied than any mental feeling can give rise to, and this is to be ascribed to the more powerful action of the principle which is put in operation. Passion calls into play those nerves only the *origin* of which lies within the sphere of its influence.

XXV. There are numerous other phenomena easy of elucidation on the laws here laid down, which have hitherto been regarded as inexplicable. It is remarked by Müller, that "*the regular succession of the involuntary respiratory movements* is very remarkable and difficult of explanation. The cause of the rhythm has its seat, as we have seen, in the medulla oblongata." * This *succession* has been shown to be a necessary condition of all nervous action. The nervous principle is expended in inspiration, and is restored during the succeeding expiration again to perform its part. He states, and justly, that it has its seat in the medulla oblongata. All nerves of motion are in relation with it:—it is the source of their power. That these movements and the diversified operations of organic life should be carried on, as efficiently in sleep as during the waking hours, is not at all extraordinary. In the natural states of the animal system, the expenditure of the principle, in any direction, will always be followed by the necessary supply to continue the vital functions.

---

* Opus cit. p. 354.

XXVI. *The cause of the first inspiration* is a subject which has exercised the ingenuity of physiologists, and has been fruitful in the suggestion of various speculations. It does not, however, present any great difficulty. At the time of birth, the animal frame is prepared to take upon itself the duties which a new existence imposes. The nervous system wants only the influence of external agents to awaken its properties, and the numerous links of the mysterious chain by which the powers of life are united into harmonious operation. The body of the child is an extensive surface, acutely susceptible of impressions from the nerves with which it is endowed; and as soon as it comes into the world, the air immediately arouses these nerves, whether of special sense or of sensibility, and the impressions which they receive are transmitted with the rapidity of thought to the brain, which in its turn reacts, and calls into activity a variety of muscular and other phenomena.

At the moment of birth commences the vigorous and uninterrupted play between the nerves and the nervous centres with which they are connected. This, to some extent, takes place in the uterus, as is evident from the frequent movements of the fœtus; and the object of these is probably to facilitate the *establishment* of relations, which are shortly to be developed in their varied and comprehensive character.

XXVII. It has just been remarked, that the nerves are susceptible of influence in two directions only; at their origin, and at their peripheral extremities. Numerous interesting facts may be adduced in illustration of the influence exerted on the nerves in the latter direction. Irritation of the nose excites sneezing; of the pharynx, or stomach vomiting; of the bladder or uterus, the expulsion of the urine or fœtus. These phenomena have repeatedly been studied by physiologists, but not in reference *to the causes which modify the distribution of the nervous principle.*

The extraordinary changes which the uterus undergoes in the process of labour are peculiarly calculated to arrest attention, and will be found to afford striking evidence in confirmation of the views which are brought under consideration. The fœtus is the irritating cause which excites the successive uterine contractions, each of which determines to the organ an increased amount of the nervous fluid, which is employed in facilitating and strengthening the next contraction, and this in its turn acts in the same manner, and thus throughout an extensive series, until at last the uterus is relieved of its contents.

These temporary changes, in the condition of so important an organ, are not explained on the prevailing doctrine of a reflex action, which takes no cognizance of *the modifications in the distribution of the nervous principle.* It is the gradual accumulation of this from every part of the nervous system, and to a degree exceeding what occurs in any other region of the muscular apparatus, that is alone capable of elucidating the phenomena. The muscular energies, which are exerted in any case, are proportionate to the concentration of it; and this, as well as other instances of sympathetic action, shows that it flows to all organs according to their activity, and equally so to all *foci* of irritation.

XXVIII. It is scarcely necessary to observe, that sympathetic affections will vary according to the severity of the exciting causes, and the susceptibility of the nervous system to impressions.

XXIX. The important office which the nervous principle performs in the lungs, will, perhaps, throw some light on the mode in which external agents disturb their free and healthy exercise, and give rise to a long train of evils. It cannot be doubted, that all vital actions are under the immediate controul of the nervous system. The principle with which it is animated, awakens and keeps in vigorous operation the mental faculties—excites sensibility and motion, —explains the endless modifications of which they are susceptible—and maintains all the other processes of the animal economy, such as secretion, absorption, circulation, and the generation of animal heat. In fact, whatever is the nature of vital action throughout the exhaustless series of animated beings, it depends on the presence of this power.

XXX. The alterations which the blood undergoes in the lungs are facilitated by peculiar structural adaptations. An immense surface is secured by myriads of cells for the exposure of it, and for the reception of air, and thus, for the reciprocal interchange between the properties of both. It can scarcely be imagined, that the vesicles in which these important though delicate processes are carried on, have no inherent vital power by which their functions are regulated, or that it can be derived from any other source than the nervous system.

According to this view, it is not difficult to account for the serious derangements of the respiratory organs, from a variety of causes, the operation of which has hitherto been little understood. A change in the quarter of the wind, or any modification in the constituents of the atmosphere, will at once occasion tightness of the chest, difficulty of breathing, or, perhaps, a serious attack of spasmodic asthma, in which the pulse—the aspect of the countenance—the labouring action of the lungs—and the diminished generation of animal heat, unequivocally indicate the inability of these organs to aerate the blood. The cause of the *first* symptoms may probably be traced to a change in the electric state of the atmosphere. But whatever hypothesis be entertained on this point, it is evident that a something has suddenly depressed the vital energies of the lungs, in consequence of which they are incapacitated for the regular performance of their duties. The seat of this depression *is in the nerves, which impart activity to the pulmonary cells.* The moment that these lose the power of dilatation and contraction, the ordinary and necessary relations between the blood and the air are disturbed; and hence the distressing results which follow.

XXXI. It is well known, that different miasms are capable of producing formidable diseases. The vitiated atmosphere which immediately surrounds a person ill of typhus fever, will frequently, in a brief space of time, give rise to this in another. The air which is inspired is unfit for the purposes of respiration. It depresses directly the nervous energies of the lungs, and the particles which constitute its morbid condition are absorbed by the blood, and wherever this flows, they will exercise their injurious influence on the nervous system. It is on this account, that, when the first symptoms manifest themselves, it is difficult to arrest the progress of the malady. We have not, strictly speaking, to treat the thoracic, the abdominal, or the head symptoms, which may fall under observation, *but the* *whole body which is involved in the disease.* The more prominent indications by which practice is regulated, arise from the peculiar susceptibility of certain organs to disorder, either from their natural constitution or pre-existing conditions of derangement. What steps are best to be pursued, under these circumstances, to remove the poison which infects the vital powers generally, do not come within the scope of this inquiry.

XXXII. A fit of spasmodic asthma occurs in some persons from inhaling the finest imaginable particles of ipecacuanha. The attenuated degree in which they are capable of acting is remarkable. The fact, however, shows how delicately balanced must be the functions of the lungs in such a case, and how acutely sensitive their nerves to external impressions. When the disease is induced the removal of it is necessarily somewhat tedious. The disturbed distribution of the blood, and its deteriorated qualities, must, to some extent, be corrected before the nervous principle can re-establish the natural functions of the air cells.

XXXIII. It is not at all an unusual circumstance for asthma to become constitutional from the undue gratification of the sensual passions, either in a legitimate or vicious manner, but especially from the latter cause. This occurs in persons of a weak or nervous temperament; and it proves how necessary it is not to disturb, by any inordinate demands, the distribution of the nervous fluid. The neglect of the law, which shows that it will flow in an accelerated current to any class of organs according to their activity, to the corresponding loss of the rest of the animal system, is fraught with grave and comprehensive considerations. The disregard of it occasions a long train of evils,—asthma, epilepsy, idiotcy, insanity, consumption, marasm, spinal, and other diseases.

XXXIV. An attack of spasmodic asthma is often excited by articles of diet. The mode in which it occurs has never been satisfactorily elucidated. It admits, however, of a simple and philosophical explanation. The efforts, which the stomach makes to act upon the ingesta, are proportionate to the duties which these impose. If easily converted into chyme, the nervous fluid required is too limited to affect other organs by its temporary concentration. If exceedingly difficult, the stomach is aroused to inordinate exertion, so that the current which is drawn to it is according to the existing necessities. The fluid, as already remarked, cannot be accumulated in one class of organs without deranging, in some degree, the functions of others. In this case, that which is required for the free and healthy actions of the lungs, is directed towards the stomach where its presence is imperative. The focus of irritation set up, is incompatible with the delicately poised relations between the nervous system and the aerating vesicles of the lungs.

XXXV. The same disease is, also, induced by depressing passions; and when constitutional an attack is the frequent consequence of them. Here again we trace the influence of the nervous system. The invariable tendency of such emotions is to enfeeble and derange every vital operation. They prompt neither to muscular activity nor social enjoyment; hence every function whether of thought, secretion, absorption, circulation, or the disengagement of animal heat, is disordered.

The study of the phenomena which arise from the deteriorated qualities of the blood, and the disturbed distribution as well as diminished production of the nervous fluid, (the inevitable effects of mental depression,) would furnish one of the most interesting and practical inquiries in the wide range of physiological pursuits. Every step in the prosecution of it would not only illustrate the pervading influence of the nervous system, but would display the nature of the relations by which the diversified instruments of life are linked into harmonious co-operation; and in contemplating the modes in which they are liable to deviations from health, a vast field, rich in resources to repay investigation, would open on the mind in reference to the origin, nature, and treatment of diseases generally.

In the foregoing remarks, we have endeavoured to bring under consideration the laws according to which the respiratory organs act, and a few of the causes by which they are modified. In our subsequent labours, additional evidence will be presented in confirmation of the views which have been developed. Before directing the attention to particular diseases, it is necessary that we should have just, clear, and comprehensive ideas on various other functions of the animal economy. *Such knowledge is the only sound basis on which the medical art can be founded.*

SECTION III.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE MOVING POWERS OF THE BLOOD.

XXXVI. A knowledge of the circulatory apparatus and its frequent derangements, is necessarily connected with every inquiry concerning the origin and nature of diseases. Whatever be their seat and character, they are invariably accompanied with changes in the qualities and distribution of the blood proportionate to their severity. One great cause, of the limited progress of medical science, is to be ascribed to the almost utter neglect of the study of this important subject.

The powers which co-operate in the circulation, have been investigated with zeal and talent by the physiologist, and much valuable information has been the result of his labours. The pathologist has, also, directed his attention to some of the striking alterations in the properties of the blood, as a cause or sequence of certain maladies; but in vain shall we consult medical writings for sound and enlarged views on disease and its treatment, based on a knowledge of the natural and morbid conditions of the circulatory system.

The phenomena of the pulse are alone no guide. For this to furnish just indications, the mind must be familiar with a variety of circumstances by which it is influenced. It is painful to reflect on the vast evils which have flowed from the misinterpretation of its language—a language which every one presumes to understand, and yet how few does it enlighten on the nature of the causes which modify the qualities and distribution of the blood; or on the consequent disturbance in the relations and conditions of all organs, arising from, or co-existing with, important changes in the nervous system. Without a thorough acquaintance with these, it would be wiser to discard altogether the consideration of its diversified expressions.

XXXVII. The powers by which the circulation is chiefly maintained are the heart, the arteries, and the capillaries. Each has a peculiar structure and specific duties. The heart is in connexion with the venous system at its termination, with the arterial at its commencement, and with the lungs. From the first it receives the blood which is no longer fit for the purposes of life and conveys it to the last-named organs, whence it is returned, after the necessary changes in its properties, to be again transmitted throughout the arterial and capillary systems. The obvious adaptation of means to an end, displayed by the respiratory and circulatory apparatus, gives to the study of it an interest which few subjects are capable of inspiring.

XXXVIII. The heart consists of four cavities—two auricles and two ventricles. The right auricle and ventricle receive and convey to the lungs the venous blood: the left auricle and ventricle receive it from these organs, in its oxygenated condition, and send it into the arteries, whence it flows to every part of the animal system. Every dilatation of these cavities is followed by contraction, so that they have a distinct period of action as well as of repose. The dilatation is the return of the organs to what may be designated their passive state;—the contraction, the exercise of their aroused energies to expel their contents.

XXXIX. The heart is largely supplied with nervous power from nerves which place it in connexion with the brain and spinal cord. As previously stated, the great sympathetic or ganglionic system of nerves, is to be regarded *as a medium for the distribution of the nervous principle derived from these organs.* Its position strikingly fits it for this office. Physiologists contend that it has peculiar properties, and presides over the functions of organic life. The important viscera, with which it is associated, furnish no evidence of distinctive properties, except in the light in which all nerves may be viewed. The optic, the auditory and the gustatory nerves, are for sight, hearing and taste, *but they are only the channels for the conveyance of impressions to internal organs,* and that, which gives them the power of exercising the office, *is the one pervading nervous principle.*

The position, relations, and connexions of nerves are modified according to the schemes of organization. The nervous fluid, which the ganglionic nerves impart to the viscera, does not differ in its nature from that which is the source of all vital action. The attempt to establish distinctions, as if each nerve was endowed with a specific agent, in place of contemplating the nervous system as one grand whole, with its centres for the production of the nervous energy and its incalculable media for the distribution of it, according to the necessities of the instruments of life, has given rise to extraordinary speculations; nor has the knowledge possessed of nervous phenomena led to extensive practical results. How could any improvements possibly be suggested, when the highest authorities were at variance on the uses and properties of the nerves? But independently of the wide discrepancies of opinion, the views, which were entertained, were not adapted to throw a flood of light on vital operations. To appreciate these and the causes of their frequent derangement, they must be studied, whatever be their nature, in relation to one universal nervous agent. The changes of which this is susceptible in its distribution, will enable the mind to trace the origin, and determine the nature of numerous diseases, as also to lay down rules of treatment, worthy at least, of respectful consideration.

XL. The successive contractions of the heart are an illustration of the law of intermittent action, which is shown to be essential to the continuous supply of nervous fluid. From the early cultivation of physiology they have excited no ordinary interest and have been variously accounted for. To the generally received doctrine of Haller only shall we advert. He ascribes the contractions to the stimulus of the blood. "He reduced," observes Bostock, "the regularity of the motion of the heart to the simple effect of stimuli, acting successively upon a series of contractile organs, the mechanism of which is so arranged that each part, when relaxed, receives the stimulus from the contiguous parts, is then roused to contraction, and by this act transmits the stimulating body to the next cavity, which is then in a state of relaxation, and prepared for its reception."*

Plausible as this doctrine may appear it is altogether a gratuitous assumption. The blood enters, and is expelled from the cavities in the manner stated, but the regular series of contractions does not arise from any stimulus which it imparts. Were such the case, they would immediately cease on the withdrawal of it. They will, however, continue in some of the lower animals, for a considerable period after the heart is removed from its position. The cause is to be found not in the blood, *but in the stimulus of the nervous fluid.* By every contraction this is expended, and during the period occupied by every subsequent dilatation, it is again supplied.

---

* Opus, cit. p. 238.

On this view it is not difficult to account for the persistence of the contractions of the heart when out of the body. It retains in common with every muscular organ, for some time after death, a large amount of the vivifying power, as is satisfactorily established by galvanic and other experiments. Various virulent poisons immediately destroy life by arresting the action of the heart; and, when applied directly to it in experiments on the lower animals, it instantaneously ceases to contract. The contemplation of these facts can scarcely lead to any other conclusion than the existence of a nervous principle, the cause of all vital phenomena whether in their natural or disturbed relations.

XLI. Blumenbach regards the explanation of Haller as established by the fact, that he was able to lengthen, " at pleasure, the motion of either side of the heart, by affording it the stimulus of the blood for a longer period than the other." * This experiment is by no means conclusive. It is well known that when the heart is out of the body and has ceased to beat, its contractions may be renewed by throwing it into warm water. It would not be inferred from this circumstance, that the water, *per se*, was the cause of the phenomenon. Its influence consists in awakening the circulation and in stimulating the nerves of the organ.

The vitality of the heart, as of every other muscle, necessarily depends on the presence or motion of the blood in its tissue, and whatever promotes either, secures to the nerves the conditions essential to their vigorous action, without which they cannot possibly perform their functions. The nerves and the blood-vessels are inseparably associated in all vital processes; but from this intimate co-operation we must not confound the peculiar duties of each. A strict analysis of the powers of life will show, that though the nerves cannot act without the blood, nor the latter produce any of its effects without the former, it is, nevertheless, unquestionable, that the direct cause of all muscular contractions and of all vital phenomena, whether mental or corporeal, is the one pervading nervous fluid.

---

* The Elements of Physiology, by J. F. Blumenbach, translated by John Elliotson, M.D., fourth edition, p. 92.

XLII. Adelon, in his admirable work, reviews the different opinions concerning the successive contractions of the heart, in reference to which he observes: *cette alternative est un fait certain, mais inexplicable dans l'état actuel de la science.**

The illustrious Müller, in attempting to explain the same phenomena, has recourse to an ingenious hypothesis. He supposes that some impediment exists to the motion of the nervous principle in the sympathetic, which is not present in other nerves, hence the sympathetic may be regarded as imperfect conductors. "This being granted, the cause of the periodic action or periodically increased action of the nervous principle on the muscular fibre, is obvious. The ganglionic parts of the sympathetic nerve will, as imperfect conductors, tend to arrest the current of the nervous fluid. The general current, on the other hand, following the peripheral distribution of the nerve, strives to reach the organic muscles. As soon as the insulating particles of the sympathetic have, in this way, received the maximum of the nervous principle, of which they can resist the progress, they suddenly communicate it to the organic muscles, and the current of nervous influence then begins again to be arrested for a time."*

---

* Physiologie de l'homme, par N. P. Adelon, D.M.P., Tome III., p. 307.

XLIII. It has been proved, in a previous work, that all muscular actions, whether voluntary or otherwise, are necessarily intermittent.† The sympathetic are as perfect conductors of the nervous fluid as any other nerves. In every case of muscular motion, a certain amount of it is expended, and, in the pause which succeeds, it accumulates to perform again its part. This does not arise from the nerves being imperfect conductors, but from the simple fact, that every muscular contraction is a waste of power, consequently, its successive repetitions require the constant renewal of the animating principle.

XLIV. That the functions of the heart depend on the nervous energy which it receives, is established by numerous considerations. Moral causes exert a remarkable influence on its contractions. At one time they are greatly invigorated—at another they are depressed or instantaneously arrested by them. It is admitted that these effects are produced through the nerves which connect it with the nervous system. Would it then be philosophical to argue that the principle which flows through these nerves, by which the contractions are modified, is altogether different in its nature from the agent which regularly excites them? Or, when it is considered, that these nerves are allowed, by the highest physiological authorities, to derive some power from the brain and spinal cord; and further, that the integrity of these organs, in the higher classes of animals, is essential to the action of the heart, shall we hesitate to acknowledge the correctness of the view which exhibits the sympathetic nerves in their comprehensive relations to the nervous centres, the animating fluid of which they are the media of distribution to all the internal organs according to their ever variable necessities?

---

* Opus, cit. p. 915.

† Philosophy of animated Nature, &c.

XLV. The nervous relations between the brain and the heart, are occasionally manifested in a peculiarly striking manner. The phenomena which present themselves are evidence of the intimate nervous associations between the two organs. When the constitution is exhausted by mental or bodily exertion, or by other causes inducing a high degree of irritability, the most trivial circumstance will give rise to violent palpitations and disturb the normal action of the nervous system. Are not these effects illustrations of the dependence of the heart on a nervous principle, the great source of which is the brain? Were not this the seat of such power and the centre from which it radiates in all directions, it would be impossible to offer a rational explanation of the variety of phenomena which fall under observation.

The same kind of argument which proves the heart to be the general distributor of the blood, may be applied to the brain in its relations to the nervous system. Every change in the action of the heart modifies to a proportionate extent the functions of the circulatory apparatus; and though not so obviously, yet not less indisputably, every altered condition of the cerebrum exerts a corresponding influence on the whole of the nervous system. Cause and effect, in both instances, rest on evidence which it is difficult to resist.

XLVI. The next step in this inquiry is the study of the nerves in relation to the arteries. That these are possessed of properties, in virtue of which they adapt themselves to the constantly varying volume of the blood; or that they to some extent aid in the circulation, will not be questioned. It is no part of our business to determine the peculiar nature of these properties. They cannot, however, be exercised independently of nervous agency.

XLVII. The sympathetic, which is in direct connexion with certain cerebral and the whole of the spinal nerves, is the source whence is derived immediately the nervous energy distributed to the arteries, which are, indeed, sheathed with its numerous filaments. It is scarcely just to imagine, that the immense nervous power which they receive, is simply for the purpose of enabling them to perform their part in the process of circulation. This may be one of their important offices, but we presume they have another of far greater interest, which has scarcely suggested itself to the physiologist. The arteries are not only the carriers of blood to the different organs of the body, *but are, also, the media for the transmission of the nervous fluid to the same;* and whether the function be absorption, secretion, circulation, or the evolution of animal heat, the exercise of it depends on the presence of the vivifying principle. Its association with the blood, wherever it flows, secures those conditions which are essential to vital action.

Did an elaborate investigation of the subject fall within the scope of this inquiry, it would not be difficult to adduce further evidence in confirmation of the justness of this opinion. The influence of the mind, on the quality and quantity of all the secretions, scarcely requires any illustration. They are increased to a remarkable degree by exhilarating feelings and are proportionably enriched with more vital properties. Depressing passions disturb the flow and nature of the secretions with the rapidity of thought. If these were not the immediate result of nervous action, their frequent and striking modifications would not be observed as an invariable sequence of mental agency.

XLVIII. The important nervous function which is ascribed to the arteries, receives additional corroboration from the consideration of an interesting fact. Gangrena senilis has been traced to the ossification of the arteries, in a number of instances sufficiently great to be regarded as a frequent cause. This condition of the vessels will not materially interfere with the transmission of the blood; and were this alone essential to vital action, the manifestation of the disease would be of much more rare occurrence. The nature of it, is a gradual disorganization of the parts affected, from the diminution or withdrawal of the vivifying principle. This change in the constitution of the arteries, will clearly intercept the course of the nervous fluid, and thus afford a rational explanation of the structural changes.

It will, perhaps, be urged, and justly, that the disease occurs, when no such condition of the vessels exists. The flow of the nervous fluid may be arrested by other causes. The obstruction to the circulation of the blood in an important artery, or an alteration in any of the minor nervous centres, whence the particular arteries receive their stimulus, will be equally efficient and will not less satisfactorily account for the result. The arteries are occasionally found plugged with coagulated blood. A case of this kind once fell under our own observation. The motion of the blood is, to some extent, essential to the transmission of the nervous energy. They reciprocally act on each other. When the circulation ceases in a vessel, it no longer exercises those functions which are necessary to call this energy into play. There is the same general relation between the arteries and this power, as prevails between it and the heart.

XLIX. The modification in the constitution of the nerves, ganglia, or great nervous centres, by which they are incapacitated for the performance of their duties, can rarely be subjected to analysis, except in particular instances. The optic, the auditory, the gustatory, or any other nerve, may be unequal to its functions, and yet the physiologist may be unable to discover the slightest deviation from normal structure.

A bar of metal becomes magnetic by heat, percussion, or induction, and yet it is impossible to ascertain the molecular change which it has undergone; so it is equally beyond our power to detect those conditions of the nervous system which are favourable, or otherwise, to the distribution of the principle by which it is animated. In either case, though ignorant of the nature of the agent which modifies the properties of organic and inorganic matter, it, nevertheless, falls legitimately within the scope of science to trace the laws according to which it acts.

L. The arterial system is subject to increased local activity, which has been considered by distinguished inquirers, as evidence of the peculiar vital properties with which it is endowed. It is frequently observed in affections of the brain. The carotids are fuller, and beat with much greater force than arteries of corresponding calibre in other situations. These facts are unquestionable. They do not, however, establish the special influence of the vessels themselves. In this instance, and in all others in which the phenomena exist, they are to be referred to the obstructions which the capillaries offer to the onward and natural movement of the blood. As this does not escape from the arteries, as under ordinary circumstances, it becomes an *increased* column to receive the impulses of the heart, and hence the distention and the greater energy with which they seem to act. It must be evident, that if the column be augmented, the same impetus, *a-tergo,* will produce effects very different from what the arterial system generally exhibits. The pulse, how great soever may be the changes in particular portions of this system, is invariably uniform in frequency, which would scarcely be anticipated, if the vessels had the extraordinary powers which are ascribed to them. This subject has been treated at length in a previous work.*

LI. The study of the relations of the nervous system to the arteries, necessarily leads to the consideration of the same to the capillaries; a class of vessels which largely constitute the structure of all organs and which are directly instrumental to all vital operations.† They may be regarded as a vast system connecting the minute arteries and veins. From the former they receive the blood which is required for the various processes of life and which, when it has performed its part, is returned to the latter to be sent to the right side of the heart.

---

* The Philosohy of the Moving Powers of the Blood. London: John Churchill, Princes Street, Soho, 1844.

† D'après ce premier apercu, il est évident que l'étendue du système capillaire général est immense, qu'elle embrasse toutes les plus petites divisions de nos parties, qu' à peine peut-on concevoir quelques molécules organiques réunies sans des capillaires.—*Anatomie Générale, &c.*, Tome II.,p. 6, par Bichat.

When we reflect on the fact that the capillaries are the seat of, or co-operate in, all organic changes, some idea may be formed of the important office which they exercise in the animal economy.

The arteries, as already remarked, are not only the carriers of blood but of nervous power, and is it to be imagined that they transmit the one and not the other to the capillaries? Is the latter arrested at the termination of the arteries? Can vital action be conceived independently of it?

It cannot be doubted that, wherever the blood moves, the nervous principle is conveyed along with it. The influence of the latter on the capillaries is proved by numerous phenomena. The turgescence of the tissues and their attraction of the nutritive fluid are evidence of it.* The flow of the saliva at the sight of what is grateful to the palate,—the blush which suffuses the countenance,—the heightened crimson or ashy paleness from aroused passion; the immediate change in the condition of the secretions,—and in the evolution of animal heat, are illustrations of nervous agency on this extensive class of vessels. Writers, however, who acknowledge these facts, do not allow that capillary circulation is aided by the nervous fluid.

---

* Müller opus cit. v. 231.

On this subject the prevailing views of physiologists are exceedingly limited. Is it philosophical to argue that these extraordinary effects, which arise from the nervous fluid aggravating or depressing vital action, cannot be adduced in confirmation of its agency under ordinary circumstances? Will it be admitted, that it quickens or retards the circulation in the face, that it modifies the quantity and quality of the secretions, when influenced by passion; and yet, that it plays no necessary part in the undisturbed conditions of the minute vessels? Such an inference would be an absurdity. The manifestation of its power, on these occasions and in such varied directions, is evidence of its operation in the usual processes of life.

LII. These facts are far more valuable and much less liable to induce to error than the experimental researches of the physiologist, by which he endeavours to ascertain the functions of the nervous system. Nature offers the former for our contemplation, and the language which they speak is too obvious to be misinterpreted. They seem designed to incite and inform the inquiring understanding.; nor can they be regarded in their aggravated character in any other light, than as phenomena unequivocally establishing the vast influence of the nervous principle. According to these views this is transmitted to all organs in proportion to their activity. The circulation of the blood is clearly governed by this law, and wherever it flows in an invigorated stream to meet the demands of excited vital action, the other will invariably pursue the same course, in an equally augmented current.

LIII. If the arteries are the carriers of the nervous fluid, which is not only essential to, but expended in vital operations, it is evident that the numerous experiments which have been performed to determine the functions of various nerves, cannot, except in particular instances, lead to any satisfactory results. The division of them may show the influence which they exercise in respect of motion, of sensation, and of the senses; but will not, with the same precision, elucidate their agency on secretion, absorption, and other organic changes; the structures in which these are effected, receiving nervous energy from the ganglionic system through the medium of the arteries.

LIV. It has been shown that the contractility and sensibility of all muscles, whether voluntary or involuntary, depend on the presence of the nervous principle.* It will scarcely be questioned that the arteries are endowed with properties, in virtue of which they co-operate in the motion of the blood. They are capable of dilatation and contraction. If the exercise of these or similar powers, is found in one case to be owing to the nervous energy, is it logical in another to refer them to a different cause? If there be any force in such reasoning—and by what considerations is it invalidated—the same power is equally efficient in the capillaries? If these do not derive it from the arteries from what other source is it obtained?

---

* Philosophy of animated Nature, &c.

LV. The study of the relations between the nervous system and the circulatory apparatus, presents in a strong light, which can scarcely fail to arrest attention, the agency of the former in all vital operations. The animating principle flows in all directions from the brain and spinal cord, and imparts to every molecule, a property, by which it is enabled to perform its part in the general scheme of organization, and by which it is associated in the mysterious processes of life.

If such be the distribution of the nervous energy, what an immense extent of surface it occupies in reference to the great nervous centres! And when it is considered, that this surface is always in intimate connexion with them and that no important change can take place in the condition of the one without immediately being felt by the other, have we not a comprehensive insight into a variety of causes influencing vital action, and into the *mode* in which they operate? In this consists the value of the knowledge. It is a lever of vast power in the hands of the accomplished physiologist, whether applied to the correction of disease or the preservation of health.

SECTION IV.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE DIGESTIVE FUNCTIONS.

LVI. In the analysis of nervous diseases, there are no organs which so frequently fall under consideration, as causes or effects of the morbid symptoms, as those which co-operate in the process of digestion. The nature of their actions and the relations which they maintain with every part of the animal system, satisfactorily explain their importance; the study of them is necessarily fraught with views of the highest value, in every attempt to elucidate the origin, character and treatment of nervous affections.

LVII. Nature, in all cases in which there is great variety or intensity of vital action, provides an ample surface. This is observed in regard to the brain, the spinal cord, the senses and the exterior of the body; it is also illustrated in a striking manner in the form and structure of the digestive apparatus. The parts which compose it are the mouth, the salivary glands, the esophagus, the stomach, the liver, the pancreas and the intestines, which are supplied with blood and nervous energy according to the duties they have to perform. It is likewise particularly worthy of remark, that the amount, which they receive of either, is constantly varying and that the modifications arise exclusively from changes in the condition of the nerves.

LVIII. As there is only a certain quantity of the nervous principle at any one moment in the animal system, the expenditure of it is regulated by laws the infringement of which is the frequent occasion of disease. It is well known that the activity of the brain, or of the muscular system, in any of its diversified modes of exertion, retards and disturbs the digestive functions. The cause is obviously the creation of sources of excited vital action, at a time when existing operations require the flow of the blood and nervous energy in the direction of them.

The fact, that such are the consequences which follow from an interference with these laws, is familiar to every well informed understanding; but it is not less true that it has not been fully apprehended by any writer. It has not, simply, a relation to the functions in question but to every class of vital phenomena in health and disease, an examination of them, and of their alleged causes, will furnish abundant evidence to show, how inadequately the origin and character of the derangements have been understood.

LIX. The economical considerations of nature are equally manifest in the digestive organs themselves. These have two successive periods of activity and of repose. The first which are exercised are the teeth, the jaws, the salivary glands, the esophagus and the stomach. The food is broken down and mixed with saliva, in the mouth, and is then conveyed to the stomach where it is elaborated into chyme. Its presence excites the secretion of gastric juice, but as this can act only on the parts with which it comes in contact, complete conversion is comparatively slow.

The secretions of the salivary glands and of the stomach, are effected at the expense of a large amount of blood and nervous power, and when these have accomplished their respective duties here, (the circumstances no longer existing which aroused and concentrated their influence) they flow to the duodenum, the liver and the pancreas,—the seat of the next stage of stimulated action. The chyme, on entering the duodenum, receives the addition of bile and pancreatic juice, and, by the agency of these and other causes, is gradually changed into chyle which is removed by the lacteals and carried into the thoracic duct, to be transmitted to the left subclavian vein. This completes the process of digestion.

The residue, which is either not nutritious, or not sufficiently elaborated to be taken up by these vessels, passes onward to the larger intestines as excrementitious matter. Here it is also a stimulus to the mucous surface, and its more fluid particles are absorbed by the lymphatics, the contents of which flow into the same common duct; the remaining portion excites the contractions of the intestines by which it is pushed forward and ultimately expelled.

LX. The object of these general remarks, is to bring prominently under consideration a fact which has hitherto not been studied by the physiologist in its comprehensive relations to health and disease, viz., *the economy which nature manifests in the application of her powers,* as exhibited in these successive vital actions; nor is it destitute of practical value to the medical inquirer. The first stage of digestion is at the expense of a large amount of blood and nervous energy, and it is mainly in consequence of this circumstance, that mental and bodily exertion so readily disturbs the digestive process. Were the requirements less urgent the influence of such causes would not be felt.

The feelings which ordinarily exist after a substantial repast—the disposition to be at ease,—the inability to apply vigorously to intellectual pursuits, are evidence of the urgency of the demand, as also of the propriety of not interfering with the sources whence it is supplied. The subsequent stages have not the same imperative necessities. The labour of the organs in which they are accomplished is light, and, hence, the mind or the body may resume their active duties without any inconvenience.

LXI. The inferences which are drawn from the consideration of these successive actions, are confirmed by an examination of the physical conditions of the organs in which they take place. Those which cooperate in the first stage of the process, are more abundantly endowed with blood and nervous energy, than those which effect its subsequent completion.

The salivary glands, the secretions of which are necessary to perfect digestion, are abundantly supplied with the two fluids. They become highly vascular when stimulated by mastication and the presence of food. The frequent indications of the influence of the mind on their functions, establishes their extensive relations to the brain. The same observations may be applied with equal force to the stomach, it being similarly modified in its conditions by the circumstances which arouse it to activity.

LXII. No question in physiology has been more warmly discussed, or led to a greater variety of experiments, than the relation between the nervous system and the functions of the stomach. It is not necessary to allude to the numerous hypotheses which have, at different times, been formed to account for digestion. It is contended by one class of physiologists, that this is accomplished by the eighth pair of nerves which are intimately connected with the organ; by another, that it is independent of nervous agency, as it is not arrested on the division of these nerves. My own experimental researches, which were extensive and variously modified, established the latter conclusion.*

It is true, that on the section of these nerves in the neck, digestion is interrupted; but as the lungs are seriously disordered by the operation, becoming congested to a degree which is incompatible with the continuance of life, it was not reasonable to suppose that the stomach, in the midst of this general derangement, in which the qualities as well as the motion of the blood were affected, could possibly execute its functions.

---

* Experimental Inquiry into the Laws which regulate the phenomena of Organic and Animal life. Edinburgh: Maclachlan and Stewart. 1829.

This objection was obviated by the division of the trachea and the insertion of a tube into it, through which the animal breathed as under ordinary circumstances. For many hours the normal circulation and temperature were maintained, and in this case, when the nervous connexion was cut off, digestion was as efficiently performed as when the trachea *only* was divided. It was less perfect than in the undisturbed conditions of the vital powers. The difference we were disposed to ascribe to the suffering which necessarily results from so serious an operation.

From this, and numerous other experiments, it was inferred that digestion was not dependent on nervous energy,—a conclusion which is unquestionably fallacious. To imagine that the eighth pair of nerves were the only source whence the stomach derived the nervous principle, shows how little was understood of the functions of the nervous system. To these nerves the attention of physiologists was exclusively directed. They are one source of this principle, and may be for the purpose of exciting the muscular contractions of the stomach,* as well as establishing extensive relations between it and the brain. In this view, we leave out of consideration the important offices of the ganglionic system—a system which we have shown, is the medium between the great nervous centres and the diversified instruments of organic life, and conveys to the latter, *through their respective arteries,* the animating agent essential to their action. The current which they receive through these channels, cannot possibly be intercepted by any means that can be devised. It will flow as long as the arterial blood circulates.

---

* This is the function which is ascribed to vagus nerves by Brachet.

LXIII. According to the principles which explain the relations between the nervous system and the circulatory apparatus, it follows that the vascularity of an organ is a measure of its nervous power; nor can we increase the one, with certain reservations, without augmenting the other in a proportionate degree. Regarding the arteries as the media for the distribution of the nervous fluid, it is not difficult to account for the extraordinary effects resulting from the reciprocal influence between the brain, and the viscera which co-operate in the process of digestion. The nervous power of the latter is spread over an immense surface, being limited only by the vital actions of which they are the seat.

If the mind has a simple apprehension of the nature of the relations between this surface and the cerebrum, it cannot fail to perceive the dependence which the one has necessarily upon the other, or the mode in which they reciprocally act in giving rise to numerous diseases. If either becomes a centre of undue activity, the nervous energy is at once modified in its distribution.

In derangements of the digestive apparatus, we have numerous illustrations of the truth of these remarks. There are scarcely any morbid symptoms that may not be produced by them. The senses may become obtuse, or acutely susceptible to impressions; the mind irritable, anxious, restless, incapable of steady and consecutive thought, or may altogether lose the integrity of its judgment; the muscles may be subject to every variety of local pain, with a tendency to increased suffering on the slightest motion.

LXIV. When we reflect that the important powers of organic life, which, in their aggregate, represent an immense nervous surface, are seriously disturbed in their operations, it is not difficult to account for these multifarious phenomena; nor does the explanation require, that a direct nervous connexion shall be traced between the diseased viscera and the remote parts of the body which are sympathetically affected. Every portion of the nervous system is pervaded by the same common principle, and whatever materially alters its circulation will be a cause sufficiently ample to produce any of these results.

If the nerves of the digestive organs are in an irritable condition, they will not only draw this towards them, in undue quantity and in a ratio prejudicial to the animal economy, but will also communicate their own irritability to the brain, the spinal cord and various nerves, with all of which they are intimately associated.

LXV. The distinction between these causes is of practical value. The constitutional effects which they produce are often exceedingly different. The prevailing ideas on the functions of the nervous system, do not exhibit any acquaintance with the mode in which the first excites and maintains disease; and, with respect to the second, they are equally deficient in sound informatiom. In support of the justness of these observations, we may allude to the thousand remedies that have been employed, and continue to be suggested in the treatment of nervous affections—remedies which have scarcely the controlling influence of a speculation, concerning the nature of their own or of nervous action, to recommend them to our notice. Is not this a melancholy proof of the ignorance which exists on the most important of all vital operations? Were these generally understood, or had we approximated in any degree towards an accurate knowledge of them, would the means in use be as various, and as opposed in character, as it is possible for the imagination to conceive?

None of the numerous writers on nervous diseases, have advanced an hypothesis that is in any degree adequate to the explanation of their nature, or the variety of symptoms which they present. Even an hypothesis would not have been without its advantages. It would have given a new direction to the energies of the intelligent. It would have broken up fresh ground, and would have stimulated the mind to enlarge its sphere of observation. The study of the phenomena, in relation to any view that endeavoured to account for them, could not have failed to elicit some light which would, at least, have facilitated their better understanding.

LXVI. Though the medical inquirer has hitherto had no theory of nervous action to guide and regulate his conduct, or such an insight into the nature of the symptoms arising from its disturbance, as to impart anything like method in the treatment of them, yet he is at once in arms, if any one ventures to propound principles on which the healthy and morbid phenomena are explicable. It interferes with his ease and settled notions of uncertainty, and he can rarely be induced to examine them with attention commensurate with their importance.

Were he imbued with a particle of that spirit which is devoted to the cultivation of mental or physical science, he would receive, if not with avidity, with feelings sufficiently alive to its beneficial tendencies, any theory that gave him the power of classifying phenomena, especially if urged on the ground of its practical bearings; and more especially, if shown to have an application not only to disease but to every condition of the powers of life.

Experience, when not enlightened by just and comprehensive principles of the animal economy, is a questionable guide: if it be the recorded observations of others, it is still less safe to follow. It loses in its transmission. It does not carry along with it the discriminating acumen by which its application was variously modified. What has experience done for the medical art? Has it established any large rules of practice? Are not the vaunted measures of to-day regarded with contempt to-morrow? This could not possibly be the case, if their suggestion and employment were based on a knowledge of the laws of the animal economy.

LXVII. The relations of the nervous system to the digestive organs will be further analyzed in the next section. The object of the foregoing remarks has been to point out, the nature of the dependence which these organs have upon the brain and spinal cord, and the extensive associations which they form with them. Every vital action, whether that be muscular contraction, secretion, circulation, absorption or assimilation, is to be traced to the principle flowing from these nervous centres. In this view, the operations of the two classes of organs are to be regarded as cause and effect, but, in studying the influence which each is capable of exerting in the production of disease, we shall perceive that the one is readily converted into the other.

SECTION V.—RELATIONS OF THE NERVOUS SYSTEM TO THE SECRETORY FUNCTIONS.

LXVIII. The practical value of the views, which treat of the modifications in the distribution of the nervous fluid and of the diseases arising from its derangement, cannot fail to be appreciated in the course of these inquiries. When it is considered that some of the highest authorities, so far from admitting the existence of an agent, common to every part of the nervous system and subject to changes in its circulation, do not allow that the nerves are necessary to the functions of organic life, it is not extraordinary that vital phenomena generally should be regarded as involved in inextricable mystery.

Professor Alison, asserts, that "*we cannot suppose any action of the nerves to be essentially concerned*" in the movements of the heart.* Here we have an important organ regulating the flow of the blood, and largely endowed with nerves connecting it with the brain and spinal cord; and further, although all voluntary muscular contractions are admitted to depend on nervous power, it is, nevertheless, contended that this performs no office in the actions of the heart.

As long as such opinions are entertained and promulgated by those who have high claims on our consideration, it will be difficult to remove the prevailing prejudices against the existence and operation of a nervous fluid, without which it is not possible to have just and comprehensive conceptions on any of the functions of life. A knowledge of the laws to which it is subject, will render easy of apprehension a vast class of sympathetic phenomena—such as the production of new actions, whether morbid or natural, in situations remote from the exciting cause; and will thus throw a flood of light on numerous vital conditions, which have hitherto perplexed and embarrassed the inquirer and concerning which there is not the slightest approximation to a rational theory, *viz.*, *the relation of diseases by extension and conversion*, which are "different modifications of one common action, directed *from unknown and spontaneous causes, to different parts.*"*

---

* Outlines of Physiology and Pathology, p. 24.

LXIX. The principles proposed to solve these difficulties merit a dispassionate examination. If it be urged that they are founded on the assumption of an agent which is not cognizable to the senses, that is no forcible objection to their truthfulness. Certain phases of the vital powers fall under observation, and if these and their varied modifications admit of explanation on these principles: if further, and here is the test of their value, they not only elucidate the origin and nature of diseases, but suggest a treatment which the enlightened practitioner as well as the emperic have occasionally found to be fraught with the highest advantages, will the view taken deserve to be considered as a wild or immature speculation?

LXX. The assumption, in this instance, is not greater than what is observed in some of the most delicate investigations of physical science. What are the theories of light — of heat, and of electricity, but scientific views, based on the supposed existence of certain conditions, and those, which the most happily explain the phenomena, are received as established.

---

* Elements of Pathology and Therapeutics, p. 316, by Caleb Hillier Parry, M.D., F.R.S.

The phenomena of light and electricity are equally attempted to be accounted for on two hypotheses, which are widely different, and hence without marked success.

It is singular that those who are the most unmeasured in their remarks against the circulation of a nervous fluid, and who pride themselves on the strictly philosophical character of their inquiries, are constantly in the habit of employing the terms, vital principle, or *vital affinities.* Is there no assumption involved in these? And has not our own an immense advantage? Neither of those has enabled the physiologist to trace the laws of vital action,—the source and progress of disease,—or the influence of remedies and other causes on the powers of life. If, in our case, the assumption is greater, the theory which is propounded is not only much more definite, but far more extensive in its application, and brings under consideration, the wide field of vital phenomena, in such a form, that it cannot possibly escape the closest analysis. If it be false, it furnishes the materials for its own refutation.

LXXI. The study of these vital affinities, or vital principle, has not afforded any substantial information on the relations of the nervous system to the digestive organs; nor has it shown in what manner these and the great nervous centres, reciprocally influence each other. In the hands of Professor Alison, they have not led him to recognize in the uninterrupted actions of the heart, or in any of the operations of organic life, *the agency of a nervous power.* According to his views, the heart contracts from its irritability being called into play by the presence of the blood. That such is the relation between the stimulus and the property in question, is an assumption, and is found not to be in harmony with unequivocal facts.

It is only on the principles here laid down in respect of nervous action, that it is possible, in any degree, to explain the relations of the nervous system to the diversified powers of the animal economy; nor do they demand any greater assumption than what is employed in every physiological inquiry. The heart, as an illustration, is said to possess irritability; and, that it is excited by the stimulus of the blood. Were the manifestation of this property observed to be modified by every change in the condition of this fluid, it would follow, supposing the influence of every other agent excluded, that the alterations in it would be the laws according to which the contractions of the heart were governed.

It is admitted that voluntary muscles contract through nervous power; and both classes of muscles can be excited by galvanism and mechanical irritations applied to their particular nerves. We are as much entitled to assume, that there is a principle in the nervous system, in virtue of which these effects are produced, as that the heart contracts from its inherent property of irritability. If we find, which we have established elsewhere, that the principle can be accumulated and dispersed, both in nerves of motion and sensation, and that the activity of organs is regulated by these conditions, it is strictly within the sphere of philosophy, to speak of such an agent as having a real existence and to attempt to define the laws according to which it acts.

The vital phenomena, both in health and disease, are evident to every observer. How does it happen, if existing methods of investigation are so peculiarly appropriate to the discovery of truth and to the extension of physiological science,—that these phenomena are regarded as profound mysteries, or are so imperfectly known as to be scarcely of any practical value? Some of the greatest errors, most prejudicial in their tendency, are committed by those who, in the cultivation of this science, discard from their consideration all occult principles, confining the attention to matters which fall under the cognizance of the senses.

LXXII. The elaborate work of Magendie on the physical phenomena of life,* is a striking illustration of the force of this remark. His investigations so far from furnishing one important principle in reference to the treatment of diseases, which should be the inevitable result of an accurate appreciation of the phenomena, have created no abounding confidence in his own mind in regard to the employment of remedies.

---

* Leçons sur les phénomènes physiques de la vie.

LXXIII. The prejudices which generally prevail against the doctrine of a nervous fluid have led to the foregoing observations. If they are well founded, we have, in some degree, removed the objections which exist on this subject.

No previous writer has attempted to unravel *the operations of an agent common to the whole of the nervous system,* showing the nature of its modifications, their relation to the constitution at large, as well as to particular organs, and the causes by which they are produced. The principles on which these are explained may possibly be questioned, but none will dispute either their originality or comprehensiveness,—qualities which ought to secure for them a candid consideration.

In studying the relations between the nervous system and the secretory organs, we shall furnish additional illustrations of the influence of the former and shall endeavour to expose the weakness of the arguments, as well as the unsatisfactory character of the experiments, which are constantly urged against the presence and pervading agency of a nervous fluid.

LXXIV. It is admitted by all authorities, whatever opinions they entertain on the nature of secretion, that the organs exercising the function are abundantly supplied with blood and nervous energy. Arteries and nerves exist throughout their entire structure. The latter are derived from the ganglionic and cerebro-spinal systems, and consequently are in direct connexion with the great nervous centres. If it can further be established, that the secretions, in health, are proportionate to the activity of these vessels and their associated nerves, in which there will be no difficulty, the evidence will go far to prove that the relation between the two is that of cause and effect. No one doubts that the secretions are elaborated from the blood, and, therefore, if these are increased, diminished, or interrupted, by changes in the condition of the nerves co-operating in the process, it would be as illogical to deny the conclusions which naturally flow from the facts, as it would to assert that the motion of the blood is not regulated by the contractions of the heart. The dependence is as indispensable in the one case as in the other, though the links in the chain of causation are not equally obvious to the ordinary understanding.

LXXV. An examination of the organs of secretion throws no light whatever on the *mode* in which it is accomplished; nor is a knowledge of it necessary to our views. How the brain is influenced by external objects, so as to give rise to vision, taste, smell, hearing or touch, is unknown, and, perhaps, will ever remain a mystery. It is acknowledged that the phenomena are the consequence of impressions made upon certain nerves; and, that they vary according to the amount or condition of the nervous matter directly and indirectly affected by them.

The evidence in favour of nervous agency in secretion, is equally unquestionable. Perception is modified by every change in the nerves of sense, and so is secretion, both in quantity and quality, by every circumstance which excites or disturbs the sources of its nervous influence. The demonstration, in the latter instance, is involved in greater difficulties, or, at least, is so regarded by physiologists. The organs of secretion possess not only nerves and blood-vessels, but a structure which is essential to their office, whether the fluids which they furnish be destined to some of the ulterior purposes of the animal economy, or cast off as excretions.

The existence of a peculiar structure in intimate combination with nerves and blood-vessels, has tended to retard the establishment of just views on the process of secretion. The efficiency of the nervous system has been lost sight of in the contemplation of the apparatus by which it is effected, as if this were not necessary to every function, whether mental or corporeal; and without it the nervous principle could not excite thought, sensation, muscular contraction, or secretion.

What is its mechanism, but such an arrangement of matter, as, when put in motion, is productive of results in harmony with its organization? Whether they belong to animal or organic life, does not in any degree affect the argument which traces them to the uninterrupted action of the nervous fluid. How beautifully soever the molecules may be adjusted, as a means to an end, they require an animating power, and, if their operations are found to be modified according to the character of the current transmitted through the nerves, which admits of direct proof, it is not overstepping the sound rules of philosophy to conclude, that this power IS THE ONE UNIVERSAL PRINCIPLE PERVADING THE NERVOUS SYSTEM.

LXXVI. The dependence of secretion on nervous energy is denied by the highest physiological authorities. Bostock remarks, "that the action of the nerves is not essential to secretion;"* that moral causes do not strengthen the opinion; and, further, that it takes place where there is no evidence of the existence of a nervous system. Blumenbach observes, that "the importance of the nervous system to nearly all the functions of the animal economy, the motion of the heart, respiration, animal heat, digestion, nutrition, and most others, is evidently great. It is, however, chiefly twofold; to excite motion in other parts, especially in the voluntary muscles, and to convey impressions made upon the organs of sense to the brain, and there to excite perception, or by means of sympathies to give occasion to reaction." †

Though this learned and truly enlightened inquirer admits the importance of the nervous system to the functions of life generally, his labours exhibit no copious illustrations of the fact, nor would it be reasonable to expect any comprehensive views on the subject, as the nervous system, according to his ideas, *is chiefly to excite voluntary motion and to convey impressions to the brain.*

---

* Opus cit., pp. 520, 525, 532.

† Opus cit., p. 196.

Secretion is referred by Adelon to the vitality of the organ, and the nerves are regarded rather as incidentally than as necessarily co-operating in the process. He says, "il n'y a que quelques sécrétions sur lesquelles porte l'influence nerveuse."* It was also considered by Bichat as independent of nervous agency.

Professor Alison, who has evidently deeply studied this branch of physiology, differs little in his opinion from the preceding writers; but as he has entered fully into its investigation, and has clearly apprehended the difficulties which surround it, we shall analyze, at length, the objections which he brings forward, as they embody the whole of what has been advanced against the necessary relation between the nervous system and the organs of secretion.

LXXVII. In reference to the doctrine which teaches this dependence, he argues, that "the following are nearly insurmountable objections."

1. "Secretion and nutrition are phenomena observed much more generally in nature than any vestiges of nervous matter; viz., not only in those animals in which no nervous system has been detected, (which must be allowed to be a doubtful case) but in the whole vegetable kingdom; in which they are at

---

* Physiologie de l'homme, vol. iii., p. 463.

least as numerous, varied, and striking, as in the economy of animals.*

These facts are, indeed, unquestionable; they are not, however, so opposed to the doctrine as may at first sight appear. The fallacy which infects all such reasoning is mainly to be referred to the prevailing opinion, THAT NERVOUS MATTER IS ALONE CAPABLE OF CONVEYING THE AGENT BY WHICH IT IS ANIMATED. Now we conceive that it is only one of the media which nature employs for its transmission. We contend that the mysterious power which operates in the animal, is common also to the vegetable kingdom. It is found that plants evolve electricity most abundantly, and in the ratio of their vigour. Let us suppose, though it may be regarded as a gratuitous assumption, that the principle which vivifies the nervous system (in confirmation of which a vast amount of evidence can be adduced,) is this particular agent which pervades all substances. In this case, would it be logical to conclude that it is not the cause of the variety of phenomena belonging to organic life, in the animal, because many of the same are observed in the vegetable destitute of nervous matter?

LXXVIII. The understanding which looks upon the subject in this light, can see in one kind of structure only the capability of conveying the principle, in place of regarding the structure as simply one of the numerous modes in which it is distributed. Though the argument derived from the following considerations may have no great force, it is, nevertheless, of some value as an illustration of our views.

---

* Opus cit. p. 55 et seq.

Every step in the progress of animal organization is accompanied with a proportionate change in the form and relations of the nervous system; and, every peculiarity in any of the superior links of animated nature, whether displayed in taste, smell, touch, hearing or sight; in the capacity of mind, muscular energy, the violence of the appetites, or in the manifestation of any other property, is always found to co-exist with an amount of nervous matter in harmony with this condition. The more marked development of the circulation, of secretion, and of the generation of animal heat, is so strikingly in relation to the nervous energy which their respective organs receive, that it is impossible to imagine that it plays no necessary part in the all important functions of organic life.

When it is considered, independently of all hypothesis concerning its nature, that a principle exists in every animal, which is the cause of certain vital operations, such as contractions of voluntary and involuntary muscles,—a principle which may be aroused in them some time after death, is it reasonable to conclude that the nerves which convey it, are not, also, the media for the transmission of the same to every other part of the animal system, or that it is not equally the agent of vital action wherever this exists?

LXXIX. The objections of the physiologist to the dependence of secretion on the nervous system, are scarcely of greater force, when analyzed in a philosophical spirit, than would be the argument that the heart and its associated vessels are not the cause of the motion of the blood; nor the lungs of its chemical changes, because it is proved that the sap in plants ascends and descends without any central organ of propulsion, without vessels possessing obvious contractility, or enveloped in a net-work of nerves; and, that it undergoes changes from its exposure to the atmosphere, which fit it for the purposes of nutrition. If, in the one case, it would be rash to set limits to the modes in which nature shall accomplish her ends, it is equally so in the other.

If, in the vegetable kingdom, we observe a diversity of means to secure the transmission and modification of the vital properties of the fluids, according to the position and age of the plant, and the season of the year, would it be the characteristic of an enlightened mind, to contend that the nerves do not convey a principle which is essential to secretion and nutrition, on no other consideration, except *that these vital actions take place in the vegetable in which no trace of nervous matter has been detected?* If the physiologist, instead of confining his attention to the *nervous matter*, had viewed it, as he does the blood-vessels, merely as the medium for the distribution of an animating agent, he would have drawn very different conclusions from the facts which he has analyzed. Such, however, is the first class of objections to the doctrine which is here inculcated. We pass to the examination of the second.

LXXX. 2. "Secretion and nutrition take place after the usual manner, in the case of the human fœtus, without a brain, in that of the fœtus without either brain or spinal cord—nay, even in the fœtus which has hardly a vestige of nervous matter in its composition."

That the learned writer should discover in these circumstances any thing that can in the slightest degree militate against the necessity of nervous agency, is, indeed, remarkable. What is the object of the greater part of the secretory organs after birth, which are designated the *recrementitious,* such as the parotid, sub-maxillary, and sublingual glands, the stomach, the liver, and the pancreas, but to effect certain changes in the food, so that it is ultimately converted into chyle and added tc the blood in circulation, to compensate for the waste resulting from the exercise of the vital powers? In the fœtus none of these organs pour out their respective fluids. How can they be called into activity without the stimulus of food? The other secretory organs, which are named the *excrementitious,* their fluids being excreted, as in the case of the urine, are equally in a state of repose. The blood and the nervous energy do not flow in the direction of any of these two classes of organs to maintain them in vigorous exercise. In other words, the fœtus is not nourished by the activity of its own organs, which is universally acknowledged. It receives from the uterus the arterial blood necessary for its nutrition, and when this is deprived of its vital properties, it is returned to the maternal system. These important facts have been established by our own experiments.*

LXXXI. According to the views which pervade this inquiry, the brain and the spinal cord, in the higher species of animals, are essential to the functions of both classes of organs, but if these are not in exercise in the fœtus, why should the absence of the other be regarded as "nearly an insurmountable objection" to the doctrine, which teaches the dependence of these organs on nervous influence? The argument is most extraordinary.

The physiologist, familiar with the phenomena of fœtal life, will scarcely urge *that the perfect repose of a large class of organs,* which, after birth, maintain the health and vigour of the animal economy, is evidence of the necessity of the co-operation of the great nervous centres in their several functions; nor could he from the consideration of the facts possibly infer, that these centres, in the ordinary conditions of life, did not furnish the nervous current which is expended in the variety of vital actions; and yet, strange, the writer endeavours to show that the absence of the brain and spinal cord, under these circumstances, is a powerful argument against the nervous theory.

The spinal cord is requisite to the motion of the limbs, but suppose, on seeing this organ wanting in the fœtus, we were to argue that the motion does not depend on nervous power, the limbs being present, while the cord is absent. His argument is precisely of the same kind. The chief instruments of organic life are only in the process of development, their functions are yet unawakened; and, contemplating these phenomena in connexion with the absence of the brain or spinal cord, or both, he arrives at the conclusion that they present nearly insurmountable objections to the nervous doctrine. We must leave to others to discover in what their force or relevency consists.

---

* The Physiology of the Fœtus, Liver and Spleen. 1831. London: Longman, Rees, Orme, & Co.

LXXXII. According to his own definition, nutrition is "the deposition of solid matter from the blood," and the term secretion is applied to the formation of fluids, which is "divided into *exhalation*, where the fluid is thrown out on an extended surface; and *secretion*, properly so called, when it is prepared in a gland, and carried off by a duct." The last-named is clearly excluded from our consideration, as it is not observed until after birth. To what extent exhalation takes place in the fœtus it is not possible to determine. It must be extremely limited on the surface of the internal viscera, these, save the heart, not being in exercise. It must, also, be proportionably small on the surface of the body, as this is not stimulated by atmospheric agents; nor does it perform those functions which, in health, are always in relation to the activity of the vital powers generally. The requirements of the fœtus for nervous power are, therefore, exceedingly circumscribed. It remains to show in what manner *nutrition*, and this degree of *exhalation*, functions directly depending on nervous influence, can be effected in those cases in which the brain or spinal cord, or both, are absent. If we succeed in pointing out sources whence this is supplied, it is evident that these cases furnish no argument against the nervous theory.

LXXXIII. 3. As the remarks on this subject will apply equally to his *third* objection, we must allow him to state it in his own words: "It appears, from the inquiries of different anatomists, and particularly of TIEDEMANN and GMELIN, and of SERRES, that the formation of the larger masses of the nervous system in the fœtus, is always posterior to many acts of nutrition and secretion; and that vessels ramify, and different textures are already nourished in every part, before nervous matter is distinctly formed there."

It is proved by the authorities which he quotes, and especially by Serres, that the various parts of the nervous system do not spring from a common centre. It is demonstrated that the brain, the spinal cord, and their numerous nerves, as well as the great sympathetic or ganglionic system of nerves, have each an independent origin. The establishment of this fact is important, and bears directly upon our views. Each having an independent origin, it necessarily follows that the absence of one or more will not affect the rest. In those remarkable and rare instances of monstrosity, in which the brain, or spinal cord, or both, are wanting, the great sympathetic nerves are present, *from which the internal viscera derive directly their nervous power*. The question is, are they the creators of it to an extent sufficient for the demands of the fœtus?

When we consider that in many of the lower links of animated nature, these nerves perform the various functions of life, it is difficult to withhold an affirmation. The wants of the fœtus are obviously extremely limited. If this conclusion be received as legitimate, it is clear, that should the nutrition of the fœtus be arrested, whenever the great nervous centres are absent, it would be a greater phenomenon, and much more inexplicable, than its gradual growth and development under these peculiar circumstances.

LXXXIV. The connexion with these centres, after birth, is an indispensable condition. The activity of the powers of life, according to the principles which are here laid down, is maintained at an immense expense of nervous energy, and can be supplied only from these sources. The nourishment of the fœtus, in those cases in which they are absent, so far from presenting any objection to the nervous doctrine, is here shown to be in perfect harmony with it.

LXXXV. In the preceding pages we have endeavoured to show, that one of the important functions of the arteries, is to convey nervous influence to the extreme vessels in which nutrition and other vital acts take place. The net-work of nerves by which they are surrounded, does not arise either from the brain or spinal cord; nor does the absence of either in any degree affect it. If, therefore, the ganglionic system of nerves is equal to the production of the nervous principle, these minute and variously ramifying nerves, will, as in after life, transmit it to every part of the fœtus.

LXXXVI. If we admit, with some celebrated anatomists, that the vessels of the umbilical cord are endowed with nerves, the question immediately suggests itself, what is their use? They would be derived from the ganglionic system—a system which is associated in all the operations of organic life; hence, with whatever structure they might be conjoined, it is natural to conclude that they would exercise corresponding functions. As already remarked, the flow of the arterial blood necessarily implies the transmission of the nervous fluid in the same direction. The invigorated circulation, in any organ, whether the result of a healthy or morbid process, is invariably accompanied with an equally excited condition of its nerves; and it is acknowledged that these, as well as the arteries of the uterus, are prodigiously enlarged during gestation.

The direct connexion between the uterus and the placenta has been placed beyond all doubt by our own researches,* and, also, by the experiments of others. Is it then to be supposed that the nerves of the former organ have no office, save that of contributing to its vascularity? Is it possible to imagine that they quit the arteries the moment that these pass into the placenta? Previously they exist as a network around them. If these views are justly founded, we have a further illustration of the fact frequently alluded to, under peculiar circumstances, *viz.*, *the transmission of the nervous principle through the same channels which convey the arterial blood.*

---

* Physiology of the Fœtus, Liver, and Spleen.

LXXXVII. 4. His fourth objection is, that "such injury or disease of the nervous system as destroys all voluntary motion and sensation of a limb, and materially affects the pulse there, although *it usually modifies,* does not stop the nutrition or the secretions there, nor prevent the usual effects of inflammation, which are analogous to secretion, from taking place; and in different experiments of physiologists, when the nerves of secreting organs were cut (*e. g.* of BICHAT on the Testicle, and MAYO on the Kidney), secretion in these organs, *although sometimes altered,* was not suspended."

He admits that injury or disease of the nervous system usually modifies, but does not arrest the nutrition or secretion of the part involved in the mischief. According to his own statement the withdrawal of a portion of the nervous energy, or a certain induced condition of the nerves, is accompanied with obvious results. The pulse of the limb is materially affected, and, also, its nutrition and secretions. On his own showing these are the consequences which flow from the causes in question. So far he acknowledges the influence of the nervous fluid on these functions. He objects to the theory of its necessity in the co-operation of them, on the ground *that they are not entirely arrested under the particular circumstances.* If it has no essential relation to these actions, why are they modified in this manner? His admission of the effects and the inference which he draws, are certainly not happy illustrations of sound reasoning. He specifies a certain amount of disturbance arising from the injury of the nerves, so far establishing in the chain of causation, antecedant and sequence, but finding that vital action, though feeble, is still continued, in place of attempting to ascertain whether any channels can possibly exist for the transmission of the nervous power, in a degree proportionate to such action, which is the only philosophical mode of proceeding, he immediately jumps to the conclusion, THAT NERVOUS AGENCY IS NOT NECESSARY TO NUTRITION AND SECRETION. He will scarcely, on a reconsideration of his argument, insist on its truly logical character. Most minds would receive his facts as evidence of the very agency which he rejects.

The nerves, which impart motion and sensibility to the limb, are in direct relation with the brain and spinal cord. Those which confer the latter property, may possibly have a less intimate connexion with the process of nutrition and secretion than would be inferred from our own views; their office being to establish sympathetic relations with the sensorium. Those of motion may, likewise, have only a circumscribed influence over the same functions, their use being chiefly to form such a combination with the muscular fibre that it shall readily obey volition.

The arguments which are frequently adduced to show the wisdom displayed in withdrawing the nerves of the viscera from the agency of the will, as this would be liable to disturb their functions, might be urged on the present occasion in support of these conjectures, and with considerable cogency. We shall leave them, however, to the ingenuity of others to apply.

If we take into account that the functions of organic life throughout the animal economy, are almost exclusively maintained by the nerves derived from the ganglionic system, sheathing the arteries and accompanying them to their minutest ramifications, it is not difficult to explain the continuance of the functions under the particular circumstances. As long as the blood flows to the limb the nervous principle will necessarily be transmitted in the same direction. That which affects the motion of the blood will equally modify the supply of the nervous energy. The inability to move the limb, will diminish the vigour of its circulation and proportionately the vital conditions of its nerves.

We should, therefore, expect from such injury or disease of the nervous system, the effects which invariably take place. No experiment can be devised to arrest the supply of nervous power to any of the functions of organic life. It is an impossibility. We may materially lessen the stream; but so long as the arteries are allowed to convey their contents, it will take the same course.

LXXXVIII. Such are the objections which have been advanced by one of the most intelligent and best informed physiologists of the day, against the influence of the nervous system in nutrition and secretion. When examined in a candid and liberal spirit what is the value of them? It is evident that he has adopted the prevailing views, which, as they accorded with his own prepossessions, did not seem to require a rigid investigation, and thus without much thought he has given them the sanction of his authority. Had he studied them with that attention they deserved, he could scarcely have expressed himself in the manner he has done. His position and high character give to his opinions great weight. From this circumstance, and the absorbing interest of the subjects, we shall proceed to the analysis of some other of his conclusions. If successful in the exposure of what we conceive to be fallacies, we shall prepare the way for the reception of more just and comprehensive ideas on the functions of the nervous system.

LXXXIX. 5. In treating of the section of the eighth pair of nerves, he observes: "In all experiments made by cutting the nerves in the neck, it has appeared, that while the secretion at the stomach was suspended or diminished, the secretion in another part, *equally supplied by these nerves,* viz., the bronchiæ, was altered and *greatly increased.*"

It is not clear what inference he intends to be drawn from these remarks. Is it to show, that the experiment is inapplicable to elucidate the influence of the nervous energy on digestion; or, that the different effects to which it gives rise invalidate altogether the nervous theory?

It is not difficult to reconcile these apparent discrepancies. *The secretion of the stomach is not suspended on the division of these nerves,* if the natural respiration is maintained. We speak from the result of an extended series of experiments. The increased secretions from the bronchiæ, are the consequence of the extraordinary efforts which the animal makes to breathe from the congestion of the lungs, which is always induced by the experiment, when the ordinary conditions of respiration are not secured by the introduction of a tube into the divided trachea.

xc. "In Dr. Wilson Philip's experiments," he says, "the secretion of the stomach, suspended by the operation in the neck, was restored by galvanism. The result is therefore conclusive *against* any influence from the nerves being essential to secretion, unless it were proved that nervous influence is identical with galvanism. Now this is not proved; and if it were, it would give little assistance in explaining secretion; because galvanism is a *single* known chemical agent, and the difficulty is, to explain the evolution of *many and various* chemical compounds, in different parts of the body, from the same blood."

We will admit that the identity of the two is not satisfactorily proved; but if it were our reasoning would be very different from his own. He says, it would throw little light on the process of secretion, because galvanism is a single agent, whereas many and various chemical compounds are evolved from the blood. Would it not be of advantage to know that all secretions are so far under the influence of galvanism, that they are increased or diminished, as well as modified in quality, according to the amount existing in the organs where they are formed? Would it not be important to know that the office of the nerves is to convey it to different parts of the body, and that their diversified phenomena were the result of its action on organized matter?

XCI. Surely the discovery would not be treated with indifference or contempt, because it did not explain *how* the agent produced muscular contraction, the various secretions, and the interesting operations of the senses. The fact would enable us to trace the exact relations between a known *single* principle and the organs which compose the animal economy.

If the nerves transmitted no other agent, allowing this to be the cause of secretion, would not the difference in the character of the secretions necessarily arise from the peculiar structure of their organs? And would not this be in harmony with every thing which is observed in nature? Both in the animal and vegetable creation, every manifestation of vitality depends on the arrangement of matter and the principle by which it is pervaded.

XCII. The physiologist rejects a single known chemical agent in the explanation of secretion, because different secrctions are formed in different parts of the body. Is it, therefore, to be inferred that each organ has its own peculiar vital principle? Does his language admit of any other interpretation? This would unquestionably be his line of argument, though he clearly perceived that secretion was suspended or restored as the nervous energy was withheld or supplied, and simply because the secretions were as various as the organs in which they were elaborated.

The cultivation of every science is the study of relations between the objects which fall under observation. How one affects another is unknown, and lies altogether beyond the reach of the human understanding. To prove that one agent exists throughout the entire animal system, and that vital conditions are modified according to its distribution, though we may be unable to explain how it acts, is an immense accession to our knowledge, and will be fraught with the happiest practical results.

XCIII. We shall proceed to examine a series of objections, which are advanced by Professor Alison against the galvanic theory of nervous action. We are not led to this step from any anxiety to establish the identity of nervous and galvanic agency. Our reasoning is not affected by any speculations on this subject. The analysis is important on other considerations. It will present, in a strong point of view, the limited and imperfect ideas which are generally entertained on the functions of the nervous system.

1. He observes, "the causes which excite, in the

highest degree of intensity, those changes in nerves by which muscles are excited (*e. g.* such causes as bruising with a probe, or pricking with a pin), seem quite inadequate to the production of a sudden and powerful galvanic influence."

If the nervous system is pervaded by an electric agent, and the brain is the chief source whence it is derived, with which extensive relations are established by the nerves throughout the animal economy; why the causes in question should be inadequate to the production of a powerful galvanic influence, we are at a loss to imagine. The injury inflicted on these nerves immediately arouses the principle within them, the sudden disturbance in the distribution of which, supposing it to be electric in its nature, is well calculated to excite the muscles to violent contraction. Are not the phenomena explicable on this view? And on what other can we approximate towards an explanation? Galvanism stimulates the muscles to inordinate action, and similar effects result from changes in the nervous system. They both increase the secretion of glands; and, indeed, the very influence which he cannot conceive to be associated in the operations of life, is manifested in a remarkable degree in several fishes; and one of the striking conditions connected with the apparatus by which it is generated, *is the existence of a large amount of nervous matter*. The value of this fact has never been sufficiently appreciated in the attempt to ascertain the properties of the nervous system. In the study of them we cast aside the light reflected from a variety of objects in nature. Our anxiety is to elicit it by rude and often ill considered experiments.

XCIV. The human mind is prone to trace analogous effects to the same cause, and, in the present instance, a departure from the rule would be as extraordinary as the objections which are urged against the probable identity of the agents by which they are produced.

XCV. 2. The writer again observes, "that these causes (such as bruising with a probe, or pricking with a pin) do not act on all nerves, and through them on all muscles which they supply, *but only on the nerves of certain muscles,* and only *on certain of these nerves.*"

These apparently discrepant effects are in perfect harmony with the views which were developed, at great length, in a late work of mine;* and they give an insight into the operations of the nervous system, with which physiologists previously were entirely unacquainted.

Though it was long since proved that motion and sensation depend on two different classes of nerves, yet the vast application of which the discovery is susceptible, in the elucidation of vital phenomena, has remained sterile. The progress and enterprise of half a century have almost left the important fact in its original state. The discovery was a great stride in physiological science, but is not every step equally so that displays the immense riches with which it is fraught?

---

* The Philosophy of animated Nature, &c.

XCVI. Is it possible to imagine that the nerves of sensation and motion have the same structural relations to the brain, and the organs to which they are distributed? A nerve of motion, in all muscles, must necessarily have peculiar relations to its fibres, in virtue of which volition in the voluntary, and the nervous principle in the involuntary muscles, excites them to action. In either case, for the will simply influences the direction of the principle, THE COURSE OF THIS IS FROM THE GREAT NERVOUS CENTRES TOWARDS THE ORGANS WHICH ARE ROUSED TO ACTIVITY. In the nerves of sensation, IT FLOWS TOWARDS THE SENSORIUM, OR TRANSMITS IN THAT DIRECTION THE IMPRESSIONS WHICH IT RECEIVES. Where then is the objection to the nervous theory in these different results? Would it not be a marvel, if the nerves of sensation were the channels through which the mind conveyed its energies to the muscles; or, if the nerves of motion were the media for the transmission of impressions to the brain? Obvious as these truths are they have not been seized, in their practical application, by any writer. If they had been appreciated by the distinguished physiologist, whose objections to the galvanic theory of nervous action it is our business to analyze, would these have been advanced as fatal to it? Would he have opposed to it phenomena which are in harmony with their respective causes?

XCVII. 3. In his next objection he observes: "we have seen that the power of exciting muscular contraction is so far from residing *in nervous substance in general*, THAT IT RESIDES ON ONE SURFACE OF THE SPINAL CORD, and not on the other,—nor in its centre; nay; it resides in one part of a nervous fibre, in the medulla oblongata, and not in another part of the same fibre, half an inch higher in the brain."

These interesting facts are explicable on the views which are here developed, and are partly explained in the immediately foregoing remarks. The nerves of motion arise from the *anterior* surface of the spinal cord; the nerves of sensation from the *posterior;* and, therefore, it is evident that the nervous principle which resides equally in both, *is not subject to the same laws in each.* The structure of the one, gives it peculiar relations to the muscular fibre; that of the other, peculiar relations to a certain portion of the sensorium which takes cognizance of impressions. The discovery of these two functions of the spinal cord is due to Magendie and Bell, and has been placed beyond all doubt by the labours of Beclard, Müller and others.

Is it not singular that the writer, familiar with this important contribution to physiological science, should adduce the phenomena as subversive of the galvanic theory of nervous action, when they are obviously not only in accordance with it, but are inexplicable on any other view? That the whole length of apparently the same nervous fibre should not exhibit the same properties, presents no difficulty. One particular part of the medulla oblongata is proved to be the seat of sensibility; and another that of motion. *The* *nervous fibre that extends beyond the seat of either*, has no longer those relations with it which are essential to sensation or motion, otherwise, why should not the brain and cerebellum, which are chiefly formed by the expansion of the nervous matter derived from the medulla oblongata, exhibit the properties of the parts whence they are derived?

XCVIII. 4. In further confirmation of his objections, the writer says, "that no galvanic action can be detected by the finest galvanometer in a nerve, at the moment when some change, consequent on its irritation, and transmitted along it, is exciting a muscle to contraction."

Our inability to discover the presence of the principle is no evidence of its non-existence. The failure may arise from one of two circumstances, either the want of sufficient delicacy in the instruments employed, or, indeed, these may possibly by their action defeat the object in view. The quantity of the nervous fluid which circulates in a nerve, when it is exciting a muscle to contraction, may be, and probably is, too small to be detected by any of the ordinary means in use.

XCIX. 5. We are further informed, "that a sensitive nerve, going to a muscle, is equally capable as its motor nerve, of conducting a galvanic current to the muscle, and thereby exciting it, *although no irritation, confined to that sensitive nerve*, has any power of exciting the muscle to contraction."

If writers on physiology, in place of adopting implicitly the conclusions and reasoning of others, would more frequently analyze the experiments brought forward, and, where it was necessary, appeal to nature themselves, works on the same branch of science would not be merely the echo of each other; nor would the progress of knowledge, especially in reference to the powers of life, be so slow or questionable. This objection of the writer is an illustration of the force of these remarks. What he states is perfectly true. The nerve of sensation conveys the galvanic fluid which excites muscular contraction, while no irritation of it induces, in any degree, the same effect. In numerous experiments which we performed to elucidate this subject, it was found that a moistened thread, or anything else, was equally as efficient as the sensitive nerve, in co-operation with the galvanic fluid, in rousing the muscle to contraction.* The nerve is simply the conductor of it, which is drawn in that direction by the position of the wire in connexion with the other pole of the battery.

---

* "EXPERIMENT I.—The negative side of the battery was connected with the heart, and the positive with the jugular vein. The heart was immediately affected; its enfeebled contraction was changed into an imperfect vermicular motion. The positive wire was afterwards brought in contact with the vena cava in the abdomen; the heart was again excited, but did not present the same peculiarity.

"EXPERIMENT II.—The negative wire, as in the preceding experiment, was in contact with the heart; the positive was connected with the mucous membrane of the nose; the contractions of the heart were instantly renewed. The same effect was observed on the positive wire being placed in the substance of the brain.

It is, as he states, impossible to excite the muscle by any irritation of the sensitive nerve, though the effect takes place in operating on the motor nerve. Is not the reason obvious? The former, were it still pervaded by the nervous fluid, has not the necessary structural relations to the muscle, to enable the irritation influencing the motion of the nervous current, to give rise to muscular contractions. As already observed, its function is to impart sensibility to organs.

c. 6. The last of his objections is one that is adduced by all physiologists as fatal to the imagined identity of nervous and galvanic influence. "That such an injury of a nerve," he says, "as completely prevents any irritation above the injured part from exciting the muscle supplied by it, *has no effect in preventing the transmission of a galvanic current from the upper part of the nerve through the injured part*, so as to excite that muscle."

We have elsewhere exposed the fallacy of this conclusion, and by an experiment which is as simple

---

"Experiment VI.—The heart was entirely separated from the body, and isolated by means of glass; a piece of thread was then tied to a small portion of the aorta connected with the organ, and was afterwards moistened. When the positive wire was in contact with the heart, and the negative with the thread, or when reversed, the contractions of the heart were again manifest. These were not characterized by an almost imperceptible motion of a few muscular fibres, but were accompanied by the simultaneous contractions of the different cavities." —Experimental Inquiry into the Laws of Life, &c., p. 277.

as it is satisfactory in its results. It is thus related in the work to which we allude :—" We conceived, however, that the electric fluid might possibly, through other channels than the trunk of the nerve, find a passage to the muscles, and, therefore, to obviate all sources of fallacy, we separated (in a rabbit) the spine, at the fourth lumbar vertebra, from the body, and then divided the limb from the pelvis, so that the two portions might be connected, at pleasure, by the nerve only. When the two ends of the nerve were in the least degree apart from each other, *the electric fluid did not produce any muscular contractions*, but they were observed as soon as the two ends were placed in juxtaposition, clearly proving that in the experiments of Müller and others, the electricity had been transmitted not directly through the nerve operated upon, but through other channels to the muscles. The experiment was most striking and satisfactory. When the space between the two ends of the nerve became moist a slightly conducting medium was established. In order to insure success it is necessary that the glass on which the nerve rests should be perfectly dry."[*]

In all previous experiments, when the nerve was tied, injured or divided, sufficient care had not been taken to prevent *the current being conveyed through other channels to the muscle*. When these were entirely excluded, the division of the nerve was as efficient in intercepting the galvanic as the nervous principle.

[*] Philosophy of animated Nature, &c., p. 145.

CI. We have thus briefly brought under review the facts and arguments of a high authority, not only in opposition to the necessity of the nervous influence in the performance of the functions of organic life, but also to the probable identity of the galvanic and nervous agency. The enlightened reader will be surprised at some of the objections which are urged, indicating as they do (whatever may be the value of our own remarks,) a limited acquaintance with the laws of nervous action, and a tendency, moreover, to receive the facts and statements of others without a due examination of their worth.

CII. Though Professor Alison regards "*secretion and nutrition as truly independent of nervous agency*," he admits "that physical impressions on, or injuries of, the nervous system, materially and variously *influence these functions;*"*—such as division of the eighth nerve in the neck, the section of the fifth nerve and injury of the spinal cord. The organs which receive their nervous energy from these sources, are greatly altered in condition. Inflammation and its supposed effects are the usual consequences. These, he says, are detected in the stomach on the division of the eighth nerve; in the eye-ball, the gums, the membrane of the nose, on the section of the fifth nerve; and lastly in the bladder, on injury of the spine.† "It may," he concludes, "therefore, be reasonably conjectured that the effect of the section of the nerve is merely to suspend the sensations of the part, and thereby greatly diminish or alter its secretions; and, as these secretions serve as a defence from the irritation of foreign matters, to which these parts are habitually exposed, *the effect of their diminution or change is to dispose the parts to inflammation from that irritation.* On this supposition, changes in secretion or nutrition are not the direct effect of the injuries of the nerves, *but are to be ascribed to the loss of the sensations by which certain secretions are habitually excited and modified.*"[*]

---

* Opus cit. p. 114.

† Aujourdi 'hui quelques physiologistes voient partout des inflammations; chaque phénomène et chaque produit patholo-

There is no small degree of ingenuity exhibited in these remarks. The phenomena which he endeavours to account for, may, however, be explained on very different views. We will first consider the nature of the causes which influence the condition of the stomach on the section of the *vagus nerves*, and in treating of this subject, our observations will be founded on our own repeated experiments. The division of them, as previously stated, invariably disturbs the respiratory functions and of course propor-

---

gique est à leurs yeux l'effet de cette cause universelle. C'est, comme je l'ai déjà dit, étendre abusivement le nom d'inflammation à des operations vitales qui sont évidemment le résultat d'un tout autre travail; c'est, partager l'erreur de Smith, et de Jean Hunter (and how many others might be added to the list), qui voyaient aussi dans chaque sécretion augmentée le resultat d'une inflammation."—*Traité D'Anatomie Pathologique par J. F Lobstein, tom. I., p.* 222.

[*] Opus cit., p. 115.

tionately the circulation of the blood. Not only is congestion of the lungs induced, but of the stomach and other viscera. They are all involved in the altered distribution of this fluid. The weight of the liver and of the lungs is greatly increased. The stomach is similarly affected. Its numerous vessels have become much more evident, giving to its mucous membrane an appearance which is regarded as indicative of inflammation. This, however, would not be the result of the irritation to which he alludes, arising from any defect in the sensibility of the organ, were the nerve which is divided one of sensation.*

The section of these nerves, when care is taken to maintain the natural respiration, does not for a considerable time produce this condition of the stomach or of the other viscera, which should be observed, *if such be the invariable result of the loss of the sensations of the parts.*

It is not necessary to remind the writer, he is familiar with the fact, that it is often impossible to discriminate between inflammation and congestion. They are reciprocally causes and effects. The former cannot exist without the latter, but this is frequently mistaken as evidence of inflammatory action.

It is singular that the physiologist, in the attempt to explain the phenomena, leaves almost entirely out of consideration, the immediate or serious changes that may be produced by these injuries of the nervous system, in the circulation and qualities of the blood. In many instances, they are the first links in the chain of causation which are disturbed, and a knowledge of the fact is essential to a rational explanation of the nature and origin of various functional and structural modifications.

---

* Brachet, in his experiments to determine the influence of the nervi vagi on digestion, concludes, that "ces nerfs sont donc destinés à entretenir *les mouvemens de l'estomac*, ce sont chargés de porter à sa couche musculaire l'action nerveuse sous l'influence de laquelle elle se contracte."—*Opus cit., p.* 205.

CIII. The next instance in illustration of his views is the following:—"The inflammatory condition, with increased and altered secretion, of the mucous membrane of the bladder, in many cases of paraplegia, *dependent on injury of the spinal cord.*"

These changes are ascribed to the loss of the sensations of the organ. In many of these cases, the power of motion, as well as sensation of the lower extremities, are destroyed. But whatever may be the amount of mischief resulting from the injury, by what facts or process of reasoning can it be shown, that the morbid secretions are owing to any defect in the sensibility of the bladder? The power of contractility is equally dependent on the nervous energy derived from the spinal cord, and will be affected by its disease.

There are obviously three effects which co-exist,—alterations in the *motory*, *sensitive* and *circulatory* conditions of the bladder; and by what refined species of analysis he can select *one*, as the cause of the vitiated or modified secretions, it is not easy to conceive. He does not inform us by what means he arrives at this conclusion. Were the injury confined to a nerve of sensation, the fact might appear to lend some support to his doctrine; but when the motory properties are equally deranged with the sensitive, the former may be urged with as much propriety as the latter, and in our opinion with greater force, as the first disordered link in the mysterious change of causation.

According to the principles pervading this inquiry, the nervous fluid and the blood flow towards organs in the ratio of their activity. All vital action is not only dependent on the stimuli which it receives, but influences and governs their direction, whether the organ be the seat of secretion, absorption, nutrition, exhalation, muscular contraction, sensation or thought. The diminution or disturbance of this vital action, by the withdrawal or interruption of its nervous principle, as in injury of the spine producing paraplegia, at once gives rise to congestion of the bladder. How can its circulation be maintained, as in health, when other conditions, essential to its functions, are either wanting or disordered? The contractility of the organ and its natural secretions, are clearly two of these conditions.

Is it, therefore, extraordinary, under these circumstances, that the secretions of the bladder are either "altered or increased?" But where is the evidence that these changes are to be traced to a modification

It is not possible to conceive a case, that more beautifully illustrates the necessity of nervous agency in all vital operations, than the one we are now considering. The study of it, according to the views developed in this inquiry, displays, in a strong light, the dependence of every species of vital action on the uninterrupted co-operation of the brain. Whatever cause circumscribes its sphere of influence, whether a modification of its own functions, or changes in the condition of nerves, produces obvious structural effects proportionate to the severity of the circumstance.

Some of the diseases to which Professor Alison alludes, as the consequences of the section of the fifth nerve, are frequently observed, and scarcely in a mitigated degree, in persons who have suffered from long continued mental depression. What, indeed, are the affections to which this does not give rise? In these instances, there is no injury or disease of sensitive nerves to account for the phenomena. The cause, however, to which they are to be traced, is to a great extent the same. The abstracted and desponding state of the mind, is unfavourable to the distribution of the animating principle from the nervous centres through their diversified channels: the eye lacks its fire,—the countenance its animation—the muscles their power of motion,—the secretory organs their activity,—in fact, the manifestations of life throughout the extended vital surface, whether *within* or *without* the body, in connexion with the sensorium, are feeble and variously disordered.

With these remarks we shall close our analysis of the views of Professor Alison against the nervous theory. Their importance and the distinguished character of the expounder of them, would be an ample apology, if any were necessary, for the space occupied by our observations.

Original and valuable discoveries are frequently objected to, by, at least, nine-tenths of readers, from an impression that they are not required for the elucidation of the phenomena on which they propose to throw light. They conclude, if familiar with the subjects brought under consideration, that these are satisfactorily explained on the prevailing doctrines of the day; or if not sufficiently informed to exercise their own judgment, they, nevertheless, conclude, that such an amount of error as is attempted to be exposed, can scarcely exist. To show the grounds on which these strictures are based, is, therefore, a necessary preliminary step towards the establishment of sound physiological principles.

CVI. Physiologists, who do not allow that the motion of the heart or the secretions generally, depend in any degree on nervous agency, nevertheless, admit, that the organs which exercise the different functions, are, in cases of emotion, influenced by it *through* their particular nerves. This doctrine is universally maintained. When critically examined what is its value? In the first place, the readiness with which impressions are conveyed to these organs, and the obvious effects which follow, *prove the existence of nervous media between them and the brain.* In the second place, if the contractions of the heart are augmented both in frequency and force, and the secretions are likewise excited, it is further established, *that the media have certain definite structural relations to the organs performing these functions;* and lastly, that the fluid, principle or energy, whatever name be given to that which they transmit, IS THE SAME IN NATURE AS THAT WHICH IS ORDINARILY EXPENDED IN THESE VITAL OPERATIONS.

The two first conclusions will not be questioned. The last is equally incontrovertible. We must allow, that the *something* which is added to what already exists in the nerves, is either the same or different. If we adopt the latter inference, it is then evident that there are two agents in the animal economy capable of producing the same effects. To *invigorate* the contractions of the heart, and to *increase* the secretions, are effects to be ascribed to the new power which is brought into play through the nerves. It will surely be permitted to have the credit of the changes induced. If a ball move at a certain rate from a given impulse, and its speed be suddenly accelerated, it must be from a second impulse, or a cause which is to be accounted for. Ordinary minds would be apt to conclude, that the cause, in both instances, was the same.

Nature is not profuse in her principles, but in her adaptations or arrangements of matter. In these she is inexhaustible. How much more consonant to common sense, (which is too little exercised in the investigations of physiology) nay, to shrewd philosophical reasoning, also, is the view, that all the variety of modifications in the functions of life, *arise from the altered conditions in the distribution of one pervading agent!*

We look upon the roots of a plant and see that it is for the purpose of connecting it with the soil, and deriving from it the materials essential to its growth; we find on examining its structure, that it is adapted to the conveyance of its fluids to the branches and leaves, and that the changes they undergo are proportionate to the luxuriance of the foliage. We observe, also, the heart and its associated vessels for the transmission of the blood; but when we direct attention to the nervous centres and trace the multitude of nerves which radiate from them, and perceive that the organs which they connect, are invariably excited or depressed by all changes in the condition of these centres, we hesitate to acknowledge, that the office of these nerves is to carry the vivifying current throughout the animal economy. According to the arguments of many distinguished physiologists, the nerves are not wanted for the heart, nor do they play any essential part on the great theatre of organic life.

The doctrine that the brain acts through the nerves, in cases of emotion, and does not regularly furnish a stimulus which is conveyed through these channels, is an absurdity, which it is most important to expose. Does it seem probable that these channels were created only for occasional use; and, indeed, for the purpose of disturbing the powers of life?

CVII. The facts in illustration of the influence of the mind on the functions of secretion and nutrition, fall within the observation of every one. The suddenness with which the effects are produced are remarkable. The secretion of milk is modified both in quantity and quality. It is sometimes at once arrested, nor is it readily re-established by a change of feelings. Müller remarks, it has been said, "that the presence of the foal has an effect on the secretion of milk in the mare." Such statements are generally received with some ridicule, or at least great distrust. The fact, however, is unquestionable, and the explanation of it shows, how beautifully adjusted are the means which nature employs for the accomplishment of her ends.

The foal, as every young dependent animal, is an object which keeps in vigorous operation the maternal affections, the exercise of which is a stimulus to the brain, and *thus maintains in healthy and excited action the nerves which establish the relations between it and the mammæ.* Mark the expression of the maternal eye and countenance in the human species, when the child is fondled or caressed! The mother eloquently speaks in every feature. Do not imagine that this state of the mind is an unimportant condition in reference to her duties. The feelings are not implanted simply as a source of gratification to reward her for her toil, anxiety and trouble. This is only part of their office. They are equally for the purpose of *stimulating that secretion on which the health and well-being of the child depends.*

In some of the lower animals, we have often watched the manifestation of the maternal emotions aroused by our interference. See the position of the head and of the whole body when couched,—the expression of the eye and of the countenance in the bitch when she apprehends danger to her young. We perceive the strength of her affections. They and the secretion of the milk come into existence at the same time and gradually decline together.

CVIII. The agency of the mind is, perhaps, as strongly exemplified in the generative organs, as in any instance that can possibly be adduced. The secretion of semen and other conditions, are modified in a remarkable manner. They are increased or diminished according to the character of the prevailing feelings. In this case, as in the preceding one, the relations between certain states of the brain and the organs affected, through the instrumentality of the nerves, are strikingly displayed.

CIX. The phenomena which result from fear, as the trembling of the limbs, profuse perspirations, the flow of urine or the action of the bowels, we have shown,* do not arise from any influence transmitted

* Philosophy of animated Nature, &c.

from the cerebrum, or from any impressions directly communicated to the parts exhibiting these effects, but from the induced condition of the brain *which interrupts the flow of the nervous fluid to them*; or which disturbs the natural relations between it and the dependent organs. The nerves, whether they belong to the limbs, the bladder, the intestines, or the surface of the body, no longer convey that amount of the nervous principle which is essential to the tone and vigour of the muscles, as well as the correct performance of other vital operations, and hence the various phenomena which are observed. The relaxed state of the containing organs, or of the secretory vessels, allows the fluids to escape.

CX. The derangement of the nervous system, which is indicated by the diminished or vitiated secretions, affects equally the process of nutrition. The materials which this requires are no longer furnished in their usual quantity, or possessing the necessary vital properties, in consequence of which the body rapidly loses its flesh. The entire change is not attributable to either of these causes, but partially, also, to a modification in the condition of the parts the seat of nutrition, which still further illustrates the importance of the nervous influence in the operations of life.

In the course of a few days or a much less period, the body, when suffering from severe mental depression, loses its development to a degree that cannot be accounted for on the ordinary ingesta being withheld, or their imperfect elaboration. These are co-existing and influential circumstances; but there are others to which writers have never directed attention.

The fluids which circulate in the extremities and on the surface of the body, retain their natural distribution as long as the vital powers generally are carried on with vigour, but when this ceases to be the case, as in distressing mental affections, they rapidly flow towards the internal viscera in which they accumulate. These are inevitable effects. The fluids are kept in their several situations by the existing vital actions and by the energy with which the heart contracts. The diminution in the force of the latter, conjoined with the feebleness of the former, are amply sufficient to explain the extraordinary alterations in the appearance of the animal system. Its bulk is made up largely of the fluids which are in constant circulation, and, therefore, whatever materially modifies their direction, will produce corresponding results in its external conditions.

CXI. These views are interesting not simply from the facility with which they elucidate numerous phenomena, hitherto unexplained; but from their practical application to the study and treatment of diseases. It is impossible for the medical student—to survey the wide field of vital action here brought under observation,—to trace the causes in operation,—to perceive the dependence of one system upon another, and to understand the mode in which the disturbance of one affects the rest, without feeling that he has acquired a command over the powers of life, which may be wielded with precision, accuracy and energy in the mitigation of human suffering, in a degree far greater than distinguished its previous exercise.

SECTION VI.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE ORGANS OF GENERATION.

CXII. There is no department of physiology possessing a higher degree of interest than the one which it is our object briefly to investigate. Whether we consider the constitutional changes arising from the development or activity of these parts of the animal system, or the variety of diseases attributable to their undue excitement or disturbance, the subject has urgent claims on our attention. The organs, in both sexes, are furnished with numerous nerves from the spinal cord, the great sympathetic, as also with branches from the par-vagum. The extensive relations which these establish throughout the animal economy, will explain the vast influence which the generative system exerts on the powers of life.

The organs are, also, abundantly supplied with arteries, the capacity and functions of which are modified by various circumstances. It is worthy of remark, that the net-work of nerves which surround them, exists to a much greater extent than in arteries belonging to the extremities. The extraordinary difference which they present in this respect, is a fact strongly corroborative of the views which ascribe to these vessels the office of conveying the nervous fluid as well as the arterial blood; and we perceive that the provision for the supply of the former, is strictly in accordance with the necessity of the vital operations, whether they are permanently or only occasionally in exercise.

It is not necessary to trace the diversities between the sexes from childhood to puberty. They are evident in the manifestations of the mind as well as the form of the body; but the salient points of difference do not present themselves, until the organs of generation receive the first stirring impulse which is to fit them for the duties contemplated in their creation.

CXIII. This period, in the female, is one of absorbing interest and the analysis of the phenomena which it exhibits, is replete with instruction. It is the beginning of a new life of thought, of feeling and of action. Sensibilities are awakened which before had no existence. A consciousness of self-respect or dignity is felt. We mark the evolution of new tastes and desires; a growing delicacy of perception, a refinement of sentiment, an aptitude and anxiety to acquire information accompanied with a reserved or coy demeanour. The addition of a few years still further modifies the character. The woman is displayed in the maturity of her hopes and in the fulness of her attractions. Confidence takes the place of timidity; the silent observer becomes the lively disputant, or employs with peculiar ease and grace the inexhaustible arts of fascination. We will briefly direct attention to the constitutional changes co-existing with these conditions, and endeavour to discover the links by which they are associated reciprocally as causes and effects.

CXIV. The growth and progress of the animal frame proceeds by imperceptible steps; the nervous system is gradually enlarging its sphere of influence, and equally so the circulating powers; the chest, the neck and the hips increase in firmness and development; and it is, when they are sufficiently advanced to receive the stimulating agency of the generative organs, that these are excited to activity. It is then that a wide range of sympathies is awakened. The brain, prepared for its new functions, has its sensibilities aroused, and re-acts on the organs by which these have been brought into play. Here is the commencement of that important *liaison* between parts thus remotely situated, which is destined to be fraught with extraordinary effects both in regard to mental and bodily manifestations. The reciprocal action, between the two, changes the entire constitution. Each becomes a centre from which radiates in all directions the stimulus with which they are charged.

CXV. The brain, in its invigorated energies, affects every part of the animal system. Its numerous nerves are channels for the diffusion of new life—for the distribution of a power that modifies the functions of every organ. The features assume a new expression. They receive the impulses of fresh thoughts and feelings which give to the countenance a definite character. The eye, if not more brilliant, is lighted up with a warmth and depth of sentiment previously not indicated.

When we consider the intimate structural associations existing between the muscles of the face and the brain, (the one as obedient to the impressions of the other, as the muscles of the extremities are to the act of volition,) it is evident that the features will pourtray, with almost unerring fidelity, the inward world of predominating thought and emotion. The ruling tendencies of the mind here leave traces which can scarcely be misinterpreted. If intellectual, they have a silent language which it is seldom difficult to read: if sensual, the intimations are equally obvious. The stirring energies of nature will burst into clear and eloquent expression.

CXVI. The modifications in the form of the features, not only at the period of life we are contemplating, but subsequently, when circumstances are favourable to the gratification of particular appetites, and especially in the female, are sometimes remarkable. The soft and winning refinement which they previously displayed in the eye, the lip and the whole countenance, is succeeded by a voluptuous manifestation. The indulgence of the passions gives to the lips greater fulness, to the eye and every feature a meaning and a form in strict accordance with them.

CXVII. In these instances, we observe the influence of the brain on external structure. The media through which it is transmitted are the nerves, and the agent is the nervous principle which flows in these directions, and is kept in vigorous play by the reciprocal action between certain excited cerebral organs and the muscles of the face. Agreeably to these views it is. therefore, natural that the countenance, at puberty, should indicate by its changes, the character of the feelings called into existence. The fact is interesting as an illustration of mental agency; but more especially from the light which it throws on the induced conditions of the cerebrum,—conditions which must necessarily impart a corresponding degree of vitality to the whole animal economy.

CXVIII. The modifications in the form and development of the neck and bust, are to be ascribed to the augmented activity of their particular nerves, arising from the invigorated energies of the nervous system generally. It is impossible to arouse the brain to new and comprehensive duties, without the cerebral nerves participating in the change. As they are only channels for the distribution of the nervous fluid, the more abundant the supply of it, or of that power in virtue of which they are enabled to act, *the greater will be the effects throughout the peripheral surface to which it is transmitted.* The agent which they convey excites the capillary circulation of the parts, the tendency of which is to draw, in these directions, a larger stream of blood, thereby to stimulate the nutritive processes. Hence the subsequent alterations in the accretion and arrangement of matter.

Though we have no evidence, which falls under the immediate cognizance of the senses, of the increased flow of the nervous principle to these parts, it must inevitably follow from the awakened functions of the cerebral organs.

CXIX. These, however, are not the only causes in operation tending to establish a striking difference between the two sexes, in the development of certain regions. There are other centres of invigorated action which co-operate with the brain in the production of particular effects, the study of which will furnish additional illustrations of nervous agency.

The uterus, from the abundance of its nerves and vessels, possesses extensive relations to the nervous and circulatory systems, and consequently will exert a proportionate degree of influence on their functions. The commencement of menstruation and its periodical recurrences, is a modification, in the conditions of the organ, which is felt by contiguous as well as remote structures. The remarkable sympathies between it and the mammæ are observed at different epochs of life.

When we consider that they are intimately connected by the cerebro-spinal and the ganglionic systems of nerves, we are prepared to expect that every important change occurring in any portions of these systems, will give rise to a variety of phenomena. The first stage in the activity of the uterus, is a new centre of vitality, the influence of which radiates in all directions. The nerves of the mammæ, chest, shoulders, neck, and of the hips and thighs, are aroused to additional duties. The capillary circulation becomes more vigorous. Hence an increased amount of nutritive matter is conveyed to these parts, the development of which constitutes the peculiar and seductive graces of the female figure. It is, however, by the repeated succession of utero-gestation and the process of lactation, that these sympathies are fully brought into action.

CXX. The numerous symptoms which occasionally present themselves, when the uterus, for the first time, endeavours to exercise the function of menstruation, are evidence of the extraordinary effects produced by it on the whole of the nervous system. Hysteria, chorea, epilepsy, mental hallucinations, neuralgia and other affections, are often observed.

A new stimulus is imparted to the nervous centres and their associated nerves, and it is the difficulty which these experience, in responding to the demands made upon their energies for a larger supply of nervous power, which explains the variety of morbid phenomena frequently evolved. If the constitution be weak, the difficulty is proportionately greater. An inability on the part of the nervous system to co-operate vigorously with the struggling efforts of the uterus, is one and the chief cause of chlorosis and other uterine diseases. The nervous fluid is required to flow in directions to which it has not been accustomed, to create fresh centres of excitement; but as these objects cannot be accomplished without disturbing the previous balance of the nervous power, sympathetic disorders will necessarily arise in numerous cases, and it is on this view only that they are explicable.

The frequent instances of neuralgia affecting the heart, chest, forehead, the side, and other parts of the body, are illustrations of the efforts which the nerves are making *to conform to the new conditions which are subsequently to govern the animal economy.* What is the severe pain of which they are the seat, but an undue concentration of the nervous principle which is sometimes, at once, relieved, when this, from the improved state of the nervous system, has an opportunity of flowing through its incalculable channels? We have elsewhere proved,* that neuralgic affections, accompanied with pain, whatever may be their situation, are occasioned by the inordinate accumulation of the nervous fluid by which more extensive relations are formed with the sensorium.

CXXI. The remarkable changes which take place in the development of the female figure, on the establishment of the uterine functions, compared with what is observed in the other sex, are evidence of the vast power which these are capable of exercising over the animal economy. In both sexes, the nervous centres are awakened to a more comprehensive sphere of action and modify the organization which is under their immediate control; but in co-operation with them, we trace the extraordinary effects which are produced by the aroused energies of the uterus. In contemplating these in their rise and progress, it is easy to imagine the wide range of sympathies excited throughout the animal economy.

---

* Philosophy of animated Nature, &c.

CXXII. The various stages of utero-gestation furnish the most striking illustrations of the influence of this organ on the powers of life generally. The irritability of the stomach, the occasionally disordered state of the bowels, the vitiated and capricious appetite, mental hallucinations, depression of spirits, a variety of neuralgic and spasmodic affections, syncope, wakefulness, salivation and other conditions, are often observed during pregnancy. A few weeks after conception, nausea and vomiting and a tendency to faintness, are ordinary symptoms.

The explanation which was given of the morbid phenomena accompanying the efforts of menstruation, applies with equal force to all these cases. As soon as the uterus is excited by the presence of the embryo, it becomes a new *focus* of activity, and as it cannot respond to the demands which are made upon it, except by calling to its aid the whole of the nervous system, this is gradually brought into co-operation. It is either unequal to, or from some cause cannot readily answer to the demands, hence the numerous derangements to which it is subject, which are evidence of the disturbance of the previously existing balance of the nervous power. The necessities for the assistance continue and in increased urgency, until at length the nervous system accommodates itself to the temporary conditions which are induced. In other words, the nervous principle and the blood flow, in invigorated currents, in the required directions. The stimulus, which is imparted to the nerves, excites the capillary circulation in their respective organs, but especially in the uterus and its appendages, and their activity here accelerates the arterial stream in the larger vessels connected with them. Hence the subsequent immense augmentation in the size of the arteries and, also, of the nerves of the womb.

CXXIII. When the uterus has brought the entire nervous system to respond to its requirements, and a new balance of the nervous energy and of the powers of life generally is established, pregnancy becomes then a healthy process, except in extremely delicate and irritable females. It communicates a grateful influence throughout the animal economy, as is evident in the greater activity of the nutritive functions. The blood is richer and more stimulating in its qualities, and the fulness of habit which exists frequently renders its abstraction necessary.

The organs, which most extensively sympathize in the altered conditions of the uterus, are the mammæ. These are greatly enlarged.

CXXIV. Let us direct attention to the organic changes which result from the various stages of utero-gestation; the consideration of them is not unimportant in reference to a correct knowledge of the conditions which exist at the period of, and subsequent to parturition. From the moment of conception, the uterus enters upon a new class of duties, none of which can be performed, save at the expense of a vast amount of nervous energy and blood. Both are gradually brought into requisition, and the *channels* through which they are conveyed, to be applicable to the wants of the fœtus, are enlarged in harmony with the demands. The highly vascular state of the uterus is evidence of their nature and extent.

The physiologist, in contemplating this circumstance, has overlooked the change equally great in the nervous system, without a knowledge of which it is not possible to explain the origin and character of numerous phenomena occurring on the expulsion of the fœtus. The brain, spinal cord, and the whole of the ganglionic nerves, have relations to the uterus, in no degree less comprehensive than those of the circulatory apparatus. The nervous fluid flows in an accelerated stream towards the seat of the excited vital actions; and these in their turn re-act on the sources whence it is derived and on all the functions of organic life, until the whole is brought into harmonious combination. The vital powers are in healthy and vigorous play, *but it is in relation to temporary and extraordinary conditions.* The withdrawal of the cause of these relations, is a shock to the animal economy. Not only has the blood, which was directed towards the uterus, to conform to other modes of distribution, but this is also required of the nervous principle. The danger and difficulty which accompany these changes, are in some measure lessened by the blood which is lost during delivery as well as by the uterine discharges.

The animal economy has, however, to adapt itself to a new state of things, and in the efforts which are made to accomplish this, whether successful or otherwise, numerous interesting and important phenomena fall under observation. The circumstance which is, perhaps, the most influential in protecting the system against untoward consequences, is the profuse perspiration which occurs at the time of, as well as subsequent to, parturition. This affords an immense relief to the plethoric state of the vessels, and likewise to the struggles which are made to distribute the vital stream according to other necessities.

The perspiration, alternating with occasional heat of skin and rigors, is a striking illustration of the character of these struggles and of the difficulties which have to be overcome. These symptoms gradually subside with the secretion of milk. The mammæ become the new centre towards which the blood and the nervous energy flow. They are the safety valve of the system at this period. Their importance, in their comprehensive relations to the powers of life generally, is strongly displayed in the effects which follow the sudden suppression of the secretion, especially when the mammæ are fully prepared to enter upon their office. In this case, we frequently observe every possible variety of nervous disorders, such as mania, epilepsy, hysteria, convulsions, inflammation of the viscera, spasmodic and neuralgic affections, and lastly, puerperal fever, to elucidate the origin and nature of which an endless series of works have been written. The consideration of these diseases will subsequently fall under our notice.

Had the distinguished authorities, who have investigated these subjects, formed just views on the functions of the nervous system, or appreciated its relations to the wide sphere of vital and mental operations, and the mode in which the principle by which it is animated is liable to be disturbed, their doctrines would have been far simpler, and the remedies suggested would have been much fewer in number and proportionately of greater efficiency.

CXXV. Whether we analyze the nervous phenomena which present themselves antecedent to the establishment of menstruation, which also frequently accompany its periodical recurrence; or direct attention to those which are observed during pregnancy, or especially consequent on parturition, we must not lose sight of the important fact, that they are attributable to the modifications in the distribution of the nervous fluid. This view will explain all the phenomena, and a just apprehension of it will materially simplify the principles of practice.

So imperfect, or delicately poised is the balance of the powers of life, in weak or irritable females, for many days after delivery, that we have seen, when everything was progressing most satisfactorily, the vital energies sink and altogether fail, within twenty-four hours, without the slightest pain or particular derangement of any function, either mental or bodily, from the employment of medicine, small in quantity, prescribed to act upon the bowels or the skin. An increased vital action set up in either direction, though by no means excessive, is sufficient to disturb the existing conditions. The nervous principle and the blood flow to other excited centres; to the surface of the body, or to the equally extended surface of the internal organs, and hence the gradual extinction of life. In cases of this kind, no class of measures produce the slightest effect. The amount of nervous energy in the system is too small to be affected in a degree commensurate with the urgent necessities; or rather if influenced, it is too small in quantity to impart the required stimulus to its dependent functions. *It is this diminution and its abnormal distribution*, which explain the inefficiency of remedies in the treatment of *delirium tremens*, when the only prominent symptom is exhaustion. We have seen patients die of this disease, whose minds were comparatively clear and collected to the last, and in whom no traces of inflammation or of any deviation from healthy structure, were discernible after death. One instance of this kind will ever be fraught with painful recollections from circumstances not necessary to state.

CXXVI. In confirmation of these views we may adduce the observation of the distinguished Cullen, who remarked, that hemorrhage to the extent of a few drops of blood, will sometimes almost instantaneously dissipate the formidable symptoms of fever. The same, also, occurs from the excited action of the skin or kidneys. The benefit which follows these results, was imagined to arise from the expulsion of peccant matter from the system. They are apt and forcible illustrations of the justness of the views which are here developed concerning the functions of the nervous system. The hemorrhage or the secretions, though extremely moderate in amount, afford the necessary relief to the nervous system. We do not say the circulatory, because this, under such circumstances, is not full to distention. Such may be the condition of certain portions of it. It is the nervous system that at once feels the full advantage. It is the disturbance in the distribution of its vital power, that occasions the flushing of the countenance, the acceleration of the pulse, the increased generation of animal heat, the burning surface of the body, the thirst, the disordered cerebral functions; as also the contrary symptoms which are ushered in by a paroxysm of rigor.

The hemorrhage or the secretions allow the unduly accumulated nervous fluid to escape, and thereby facilitates the establishment of the natural balance of the energies of life. The accumulation may take place in any organ and give rise to these effects.

How seldom we succeed in our attempts to imitate these salutary efforts of nature! We may act upon the skin, the kidneys, the lungs, the liver or the bowels, but the fever in spite of our exertions will run its course. The outlets which nature selects are according to her necessities; and, perhaps, usually present themselves where the morbid symptoms had their origin, consequently the excited action, causing what is designated a crisis, OCCURS PRECISELY WHERE THE RELIEF IS REQUIRED. Many interesting facts may be adduced in confirmation of this view, which, however, we shall leave to a subsequent occasion.

In our endeavours to walk in the footsteps of nature, we have recourse to the abstraction of blood, to purgatives, diuretics or diaphoretics, and probably the very results which we produce, so far from being in harmony with the wants of the system, are in direct opposition to them.

We have been led to these remarks from the support which such cases furnish of the influence of the nervous system. The phenomena which they bring under consideration, are explicable only on the principles here laid down.

CXXVII. There is no subject connected with pregnancy, that possesses greater interest than the power which it exercises in arresting the progress or development of disease, particularly pulmonary consumption. Its salutary tendency, in this respect, is universally admitted. There are, however, numerous exceptions to the rule. When the system is exceedingly delicate and unequal to the demands made upon it, that which, in other circumstances, is an invigorating process, exhausts the energies of life.

The beneficial influence may be thus explained: the excited functions of the uterus become a new *focus* of vital action, and so far will divert the undue *concentration* of the nervous fluid and blood from the lungs, which concentration is requisite to the disorganization of their structure. The part which the nervous principle plays in its gradual deterioration has not been traced by any writer. The general character of the morbid effects and the symptoms by which they are indicated, have been elaborately studied; but the nature of the steps, or the causes leading to, and producing these effects, from their earliest manifestation to their most aggravated form, have scarcely received any attention, certainly not in a degree commensurate with their importance. The unsettled and ever varying modes of the treatment of consumption, are the best evidence of this truth.

Pregnancy finds other employment for the nervous energy, It is not only appropriated to the creation of new life in the womb, but from the changes which it induces, *it diffuses new life throughout the animal economy.* The circulatory system is aroused to additional duties and distributes a more vitalized stream to every part of the body. The improvement in its qualities and the more vigorous action of the nerves, give greater tone to the naturally feeble conditions of the constitution.

These results, though flowing from the temporary functions of the uterus, do not cease on their termination. Lactation, if borne with facility, continues the salutary process.

The protection, which is thus afforded against the progress or development of pulmonary disease, does not arise simply from the direct influence which the excited functions of the uterus exert on the lungs, though this is not an unimportant consideration, *but is mainly attributable to the energy which is imparted to all structures.*

The stomach, which was previously weak and performed its functions with difficulty, is enabled to take a greater quantity of food and to digest it more perfectly; the bowels which were frequently torpid or relaxed, act with greater regularity; the circulation is more vigorous; the nervous system is less excitable; the secretions are more natural, and the activity of nutrition is shown in the flesh which is added to every part of the body. When pregnancy fails to produce these general conditions, it is a questionable guarantee against the inroads of consumption.

CXXVIII. In the foregoing observations we have confined the attention to the consideration of the generative system in the female. Its manifestations at puberty, in the other sex, are almost equally well marked and not less worthy of being studied. The tastes and pursuits of the two are not more opposed than the character of the organic changes which take place. With the growth of the testicles, their power of secretion and augmented sensibility, the cellular tissue becomes much firmer, the muscles are gradually developed, the capacity of the chest is greatly enlarged, the appetite is keener and the digestive organs more active; the circulatory apparatus is invigorated and transmits a richer and more stimulating current. The feelings and the mental faculties are proportionately modified.

A new world breaks upon the mind, but widely different from that which bounds the desires of the female. The anxiety of the one is to fascinate and to heighten the attractions which nature has given her, and to exercise those arts which extend the sphere of her power. How varied soever the charms with which she embellishes the picture, man is invariably the object to which they have a relation. The other, fired by the promptings of ambition and distinction, is aroused to activity. He enters with all his soul into athletic sports; he warms his imagination with the exploits and achievements of by-gone ages; he glows with admiration at the contemplation of excellence; and the feelings which impart an interest to what is good or great, are directed with determined energy towards the gratification of his wishes. To him woman is only an incident in his restless and chequered career though one that materially influences his character and fortune.

CXXIX. The active pursuits of the youth are essential to the development of the animal system, to the acquisition of those organic qualities and of that experience which are to fit him for the duties, the struggles and the toils of life, and it is important that they should be cultivated. The neglect of them is not only injurious in stunting the growth of the body, in marring the beauty of its proportions and in rendering it unequal to vigorous exertions; but is most prejudicial in giving rise, which it too frequently does, to a morbid degree of sensibility. The mode in which this displays itself depends mainly on the constitution of the mind; but it often leads to the vicious or unnatural indulgence of the sensual appetite, which destroys the health and lays the foundation of numerous diseases.

The facility with which the passion can be gratified, is seductive, and occasions the repetition of the act until the fatal habit is acquired. To this cause is to be ascribed, and to a greater extent than is generally imagined, epilepsy, insanity, severe head-aches, inability of mental application, weakness and imperfection of sight, disease of the heart and lungs, debility and pains in the back and loins, impotence, various neuralgic affections, despondency, fretfulness and a high degree of sensibility which embitters the course of existence.

Our attention, from accidental circumstances, was early directed to the investigation of this subject, and our opportunities for observation have been extensive. We are acquainted with cases, in which the growth of the brain was decidedly arrested by aggravated indulgence.

CXXX. We have, in a previous work,* briefly treated of the nature of the relations which exist between the generative system and the brain; and the further development of the views will elucidate the phenomena which result from the reciprocal action of the two, in health and disease, with a degree of precision and accuracy exceeding what has hitherto distinguished our knowledge of them.

CXXXI. One of the most remarkable circumstances connected with the organic changes at puberty, is the alteration which takes place in the character of the voice, which is shown to arise from the increase in the capacity of the larynx. That this, and the appearance of hair upon the chin and upper lip, are largely dependent on the activity of the generative organs, is unquestionable; and the degree in which they are developed is a general measure of their power. The nature of their influence is peculiarly exemplified in those miserable beings, who, in early life, submit to an operation to prevent the ordinary structural modification of the larynx. The result is invariable.

CXXXII. Let us endeavour to trace the channels through which the agency of the generative system is communicated to the vocal organs. Its awakened energies affect directly the nervous centres and the ganglionic nerves. The former, are aroused to a wider sphere of action, and are stimulated by a variety of impulses to which they were previously strangers. These, as already remarked, are conditions which must necessarily establish, through the cerebral nerves, proportionately enlarged relations to the whole animal economy. The evidence of the influence brought into play is observed in the altered form and expression of the features, in the tendency to muscular exertions, in the augmented capacity of the chest, in the more vigorous circulation of the blood and the increased generation of animal heat.

---

* Philosophy of animated Nature, &c.

The structural change in the larynx is one of a series of effects which are attributable to these causes. It may appear more evident, from the mode in which it manifests itself, but it is not greater in degree than what takes place in other organs. The vocal instruments, as part of the respiratory system, sympathize with the general organic alterations.

CXXXIII. There is, also, another source of nervous power which co-operates with the brain in the production of a new class of vital conditions, viz., the ganglionic nerves. We have elucidated their influence in treating of the generative system in the female. They derive from the same system in the male, a stimulus which excites them to increased activity. As they preside over the functions of organic life, drawing the principle by which they are animated from the great nervous centres, we perceive the beauty and comprehensiveness of the laws which regulate the gradual growth and development of the animal system.

CXXXIV. The knowledge of these laws and of the mode in which they are liable to be disturbed, by sensual excesses and other causes, will enable us to explain the origin and nature of numerous diseases which have hitherto been involved in great obscurity. How futile has been the attempt of previous labourers in this department! The diversified opinions which exist, and the equally discrepant practical measures which are recommended, are the best evidence of their failure. Nor is it possible to arrive at juster and more enlarged views, unless we believe in the pervading agency of a nervous fluid, susceptible of increase and diminution generally, as well as locally.

SECTION VII.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE MUSCULAR APPARATUS.

CXXXV. As nervous affections are frequently accompanied by a manifest disturbance in the properties and action of the muscles, it is important that enlightened ideas should prevail concerning the mode and degree in which the nervous system co-operates with these organs. It will scarcely be presumptuous to assert that such have not yet been attained. The extraordinary discrepancy which exists on the subject amongst the highest physiological authorities, is alone sufficient to prove the want of correct and comprehensive principles.

CXXXVI. The muscles are usually divided into the voluntary and involuntary, and though some partake of both qualities, the classification is useful as marking an essential distinction between them in reference to the mind. The one class is called into play by the will; the other is withdrawn from its influence. We shall subsequently endeavour to show that the agent, in virtue of which all muscular contractions take place, is common to both, volition being only the power which modifies its direction in the nerves. It is only on this view that a variety of muscular phenomena, in health and disease, admit of a rational explanation.

CXXXVII. The voluntary muscles are abundantly supplied with nerves from the spinal cord as well as from the sympathetic in association with the arteries. The ultimate distribution of the nerves is not satisfactorily ascertained. They grow softer as they successively divide into finer filaments, and, finally losing their neurilemma, are imagined to be blended with the primitive muscular fibre. The difficulty which is experienced in tracing them, is evidence of their minute and general diffusion. This class of muscles are stated by anatomists to be endowed with a greater amount of nervous power than any part of the body,—save the senses and the skin. Though in health, or under ordinary circumstances, they are governed by the will, in disease they not only frequently act independently of it, but in opposition to its efforts to regulate their movements.

CXXXVIII. The involuntary or internal muscles, as the heart, the stomach, the intestines, the urinary bladder and others, have connexions with the cerebro-spinal and sympathetic nerves, and derive from these the nervous power by which they are enabled to perform their vital operations. The amount which is transmitted to the two classes of muscles, in the twenty-four hours, is not, as we have endeavoured to show,* to be estimated precisely by the size or number of the nerves. This is one condition, but there is another, which had not suggested itself to the physiologist, *viz.*, the more or less persistent character of the muscular action. The voluntary muscles have long periods of repose, during which their exhausted energies are restored. The involuntary and semi-voluntary generally have no uninterrupted rest.

CXXXIX. The muscular system possesses little sensibility. The limited extent in which it is indicated, led Haller and his followers, among whom there are many distinguished names of the present day, to contend that irritability is an inherent property of the muscular fibre. "Until the anatomical question respecting the nerves of the heart be decided," observes Bostock, "it will be impossible to build any physiological hypothesis upon them, but the comparatively *insensitive* state of the heart is admitted by every one, and may be adduced as an objection to the doctrine of the neurologists, *even were the existence of its nerves fully established.*[*] From Haller downwards the sensibility of organs has been regarded as a true *measure* of the nervous power with which they are endowed. Such reasoning might be excused in those, who had not the benefit of recent physiological discoveries to enlighten them; but what shall we say of recent inquirers who had these advantages, who were able to appreciate the important distinctions between nerves of *motion* and of *sensibility*, the functions of which are so dissimilar? Neither can be a measure of the other.

---

* Philosophy of animated Nature, &c.

CXL. In the foregoing investigations we have endeavoured to show that the variety of vital actions brought under notice, are necessarily dependent on the nervous energy. In combination with peculiar structural adaptations, it produces the wide range of phenomena to which we have briefly directed attention. What is irritablity or muscular contraction, but such an arrangement of organic matter that when animated by the nervous principle, it exhibits its particular properties? That its co-operation should give rise to these effects, is not more singular than that secretion, absorption, circulation and the generation of animal heat should be the results of its influence. The senses and the whole of the mental faculties are modified in their manifestations by every change in the distribution of it.

CXLI. Is the muscular system to be an exception to its pervading agency,—a system, whatever may be the character of its operations, connected with the nervous centres and receiving from them, either directly or indirectly, the nervous current? This flows to all parts of it either through distinct nervous cords, or through the net-work of nerves which invelope the arteries. The media through which it is conveyed are lost in their ultimate combination with the muscular fibre. We are now, from our own repeated experiments, in a position to show that muscular contraction may be accelerated or retarded, at pleasure, by modifying the distribution of the nervous energy. Previous, however, to adducing such evidence, it is necessary to consider, at length, the objections which prevail against the nervous doctrine. This is an essential preliminary step. The exposure of fallacies will clear the ground for juster views.

---

[*] Opus cit., p. 178.

CXLII. The first distinguished authority to whose arguments we shall advert, is Professor Alison. He adopts the reasoning and conclusions of Haller. Of the two theories of muscular contractions, "the first is," he says, "that all muscular parts, *derive a supply* of some kind of *influence or energy, from the brain or spinal cord,* through the nerves, which enables them to contract, or *renders them irritable.* The second is, that muscles, although not actually drawing supplies of vital power through their nerves, are *yet dependent on nerves for every occasion of the exercise of that power*—all stimuli, which excites muscles to contraction, *acting first on the nervous filaments* which enter muscles, and *through them on the muscular fibres.*"

"To the first of these opinions the following appear to be insurmountable objections."

"1. Indications of a vital power of contraction are a much more general fact in nature than the existence of nerves, being seen not only in the lowest class of animals, where the existence of a nervous matter is still doubtful, but also, in vegetables."*

The learned writer, in arguing against this theory, does not restrict his objections to the supposed agency of the brain and spinal cord, but clearly to the necessity of "nervous matter" in the production of muscular contraction. This admission gives to his objections a much more comprehensive character. In the following critical examination of them, it must be kept in mind that we are replying, also, to the arguments of Haller and his partizans. The intelligent Edinburgh Professor adduces no new facts, nor any additional illustrations in support of the imagined *vis insita* of the muscles.

CXLIII. As previously remarked, in treating of the functions of secretion, we are not taking a large or philosophical view of the operations of nature, when we confine the action of the animating principle of the body, which is designated nervous, from its association with nervous matter, *to any particular structure.* The nerves, in the animal system, are the channels for its distribution. In the vegetable, it has other media by which it is enabled to excite secretion, absorption, assimilation and the generation of heat. Various plants exhibit an extraordinary degree of contractile properties. They open and close with the rising and setting sun. When touched, they immediately fold up their leaves. The light of day materially influences their vigour and growth. They are likewise powerfully affected by atmospheric changes.

---

* Opus cit., p. 10, et seq. The Italics are his own.

The study of these phenomena suggests to the mind an obvious inference, *viz.*, that they are possessed of a *something* which renders them exceedingly susceptible of impressions; and that this, as in the animal body, has various modes of expression. The analysis of these facts, but more especially the consideration that the active principles in nature are few, necessarily leads to the conclusion, that the diversity of the results to which they are instrumental, are to be ascribed to the modifications of organization.

CXLIV. The striking analogy between the animal and vegetable in the processes of secretion, absorption, nutrition and contractility; and also the remarkable resemblance in the laws regulating the propagation of the species, a difference of sex being required, and the animating agent of the one being essential to the impregnation of the other, present to the philosophical understanding a large and interesting class of phenomena, the contemplation of which can scarcely fail to induce the belief, *that these throughout nature are* *attributable to the same vivifying principle.* According to this view there is nothing extraordinary in the contractility of plants. They are all susceptible of the influence of external causes, but some in a much higher degree than others,—differences which are likewise observed in the animal kingdom.

CXLV. The argument which is used against the necessity of the nervous system for the exercise of irritability, is equally fatal to the necessity of the muscular fibre for the manifestation of it. This property exists in the vegetable where the same structural conditions cannot be traced.

CXLVI. We are further informed that the same phenomenon is remarked in the lowest class of animals, "where the existence of a nervous matter is doubtful." The absence of the brain, spinal cord, ganglionic or other nerves, is no evidence that nervous matter, in some form, does not preside over the functions of life. Or suppose that it cannot be discovered, the fact does not authorize the inference that the power which imparts to it and to every organ of the animal economy the endowment of vitality, is not in active operation. If in place of confining the attention to the particular structural conformations of the nervous system, in the endeavour to determine its agency, we studied the properties and modes of action of the principle by which it is pervaded, we should arrive at juster and more comprehensive conclusions.

CXLVII. 2. His second objection is, that "the human fœtus has often come to the full size (implying long continued exertion of contractile power in the organs of its circulation) without a brain or spinal cord; and in all cases, during the growth of the fœtus, the formation of vessels precedes that of nervous matter, and the organs of circulation are in full operation, when the larger masses of the nervous system are still very imperfectly developed."

The fallacy of such arguments we have exposed in the section on secretion. The arteries are not formed *anterior* to the development of nervous matter. The ganglionic nerves, which are directly instrumental in the motion of the blood and of all organic changes, are not derived from either of these nervous centres, *but have an independent development*, and are invariably present when these are absent. The arteries cannot come into existence without their net-work of nerves. The manifestation of muscular contractility in such cases of monstrosity, so far from being a legitimate ground of objection to the nervous doctrine, is, in our opinion, *a striking illustration of the peculiar functions of these nerves.* The absence of the brain or spinal cord, or of both, does not interrupt the development or growth of the fœtus. The circulation and nutrition go on as under ordinary circumstances. With what degree of logical accuracy can we deny to this class of nerves their essential co-operation in these functions, when it is admitted that they are deranged by moral and physical causes, which disturb the action of the nerves presiding over them?

The learned Professor acknowledges that certain necessary relations exist between the organs which exercise these functions and their particular nerves. Is not the conclusion equally inevitable with respect to the irritability of the muscles? Whatever may be the character of the malformation these nerves are never absent. Their inseparable association with the arteries would seem to imply the extraordinary solicitude of nature to protect, as far as possible, the important operations of organic life.

CXLVIII. To adduce the absence of the brain and spinal cord, as an *insurmountable* objection to the nervous theory, displays a limited knowledge of the laws which regulate the development of the fœtus, as well as of the objects contemplated in the formation of these nervous centres. Have they not functions to perform necessary to man in the scale of creation,—to his intellectual and sensual enjoyments,—to his varied muscular movements,—to all his organic functions, by which the supply of nutrition keeps pace with the expenditure of his powers,—all which actions, so far as they are dependent on the brain and spinal cord, are unexercised in the fœtus? It receives from the maternal system the nutriment essential to its development, the elaboration of which had called into play the energies of the brain and spinal cord, and without which it could not have been accomplished. If these organs are not required by the fœtus, why should their absence be an argument against the efficiency of the organic nerves (which always co-exist with the arteries) in secretion, nutrition and the limited manifestation of muscular contractility in the instances of monstrosity? Such are the objections which were urged by Haller, and from his genius and high character had no ordinary weight, and which have been transmitted through a series of distinguished names to the present day.

CXLIX. 3. It is again stated in opposition to the nervous theory, that "the involuntary motions of the organs of circulation have been found by many physiologists to continue vigorous, even in warm blooded animals, after the removal of the brain, or even of both brain and spinal cord, provided that the exposure of the blood to the air is secured by the substitution of artificial for the natural respiration."

The circulatory organs are directly dependent on the ganglionic system of nerves for their contractile properties, which system, by the destruction of the important nervous centres, is only so far involved as it affects their structural connexions with them. These connexions are essential to the *full play* of the energies of life. They are the media for the conveyance of the nervous current to all the viscera according to their varying necessities; but what is the character or extent of these when the animal has lost its brain and spinal cord? Are digestion, secretion and nutrition in active operation? The destruction of the great nervous centres necessarily circumscribes the sphere of vital action. The continuance of the circulation, for a limited period, is, perhaps, the only remaining and unequivocal indication of organic life. The phenomenon does not establish the inference, which the writer deduces from the experiment, that the brain and spinal cord are not essential to the various organic functions; and still less that these are not dependent on nervous power. The heart, the arteries and the ganglionic nerves, do not lose the principle by which they are animated the moment that their connexion with these organs is broken. As long as the principle exists, other circumstances being favourable, it will maintain the circulation of the blood.

CL. In researches of this kind physiologists lose sight of the important fact, that the viscera are supplied with nervous power through the medium of the arteries and of numerous nerves directly from the sympathetic—sources of nervous energy which do not immediately fail on the removal of the brain or spinal cord. And, therefore, what is the value of such experiments? They do not in any degree elucidate the question at issue. Were the destruction of these organs accompanied with the instantaneous annihilation of the nervous principle throughout the body, the phenomena resulting would then be worthy of consideration, but clearly not otherwise. It would be as philosophical to argue, that the wheel which revolves from the impetus of the water flowing from the reservoir, should at once be arrested on interrupting the mountain stream which keeps up the required supply. The two have strong points of resemblance and the conclusion in either instance would be equally illogical.

CLI. 4. "No interruption of the contractions of the heart," he says, "or other strictly *involuntary* muscles, has ever been produced by cutting the nerves by which they are immediately supplied."

It would, indeed, have been strange had this phenomenon been observed. The writer misconceives all together the difference between the nervous conditions of the voluntary and involuntary muscles. He demands, in confirmation of the nervous theory, a result which is an impossibility—a result to the production of which no experiment is adequate. The voluntary muscles have large nerves by which they are connected with the spinal cord and brain, and through which volition is transmitted regulating their action. To destroy these nerves is to paralyze the parts to which they are sent. Here is an obvious and uniform effect. The operation does not immediately destroy the irritability of the muscles, *the property in virtue of which they* CONTRACT. It only affects their subserviency to the will. The *involuntary* muscles, as the heart, the stomach, the intestines and others, *have no large nerves* which have the same relation to them, as the above nerves have to the *voluntary* muscles, consequently they do not admit of a corresponding experiment. Their sources of nervous energy are the numerous branches derived from the ganglia of the sympathetic and the net-work of nerves which accompany the arteries, the agency of which cannot be withdrawn to enable us to test the extent of their co-operation.

CLII. Were it possible to cut off the supply of nervous power to the voluntary or involuntary muscles, there would then clearly be no difficulty in determining the nature of its influence. It will flow, however, as long as the arterial fluid is conveyed to these organs. Its channels can be interrupted only by the destruction of the nerves as well as of the arteries connected with the muscles, an operation which would leave no living matter to manifest its properties.

Had Haller and his followers been sensible of the latter source of nervous power, the subject of irritability would have been discussed on very different grounds, and would have led to more comprehensive views concerning the functions of the nervous system.

So far, however, from the nerves enveloping the arteries being regarded as a source of nervous energy, that when the researches of Behrends and Sœmmering tended to show that the heart receives no nerves,—save what are distributed to the coats of these vessels, the circumstance was considered even by the moderate opponents of Haller, *to prove that the muscles are not dependent on nervous agency, as if the channels through which it flowed* were a point which in any degree affected the question.

CLIII. Though it is not possible to present the conclusive experiment, in reference to the contractions of the heart, which the writer conceives, but with little propriety, to be essential to the nervous doctrine; it is demonstrated by our own as well as by the multiplied experiments of others, that these contractions can be invigorated or weakened, accelerated or retarded, both by mechanical and chemical means acting on the brain or spinal cord. He acknowledges these effects, but endeavours to invalidate their force by the oft-repeated argument, that the nerves are unquestionably *media* for the transmission of moral and other influences to the involuntary organs from the great nervous centres.

If we could *arrest* the motions of the involuntary muscles by the division of their nerves, according to his mode of reasoning the evidence would be perfectly conclusive. To *modify* or *interrupt* these motions, through the same nerves, by causes which excite or depress the functions of the brain or spinal cord, is, nevertheless, regarded as a phenomenon of no value, and is not admitted in any degree to elucidate the subject under discussion. Such is the line of argument which distinguishes the enlightened followers of Haller.

CLIV. 5. In his next objection he observes, that "although the muscles destined to voluntary motion are no longer moved by the will, after the section of their nerves, they continue thereafter to show their irritability, on the application of stimuli to themselves, or to their nerves below the section, *as long as* *their nutrition and organization continue pretty entire;* and contractions may be excited by direct and continued irritation in the muscular fibres, fully as long as in muscles of which the nerves have been cut, as in those, the communication of which with the brain and spinal cord, through the nerves, is entire."

Many of the previous remarks are an answer to this objection. The contractile properties of muscles depend, as we have stated throughout this inquiry, largely on the ganglionic nerves which form a species of nervous membrane around the arteries; and, as long as they are maintained in vigorous action the animating principle is imparted to the muscles. Indeed, so important are they, that when the main vessel of a limb is tied, *the power of motion is either wholly or partially lost,* until collateral branches are sufficiently augmented to convey the necessary stream of blood. In the speculations which have been formed to explain the result, none have taken into account that the operation diminishes the flow of the nervous as well as of the arterial fluid to the muscles. The distinguished writer lays it down as an essential condition for the persistance of irritability, where the nerves are divided, that the "nutrition and organization" of the parts which they supply, must be "pretty entire," which is in direct confirmation of our reasoning.

The experiments to which Professor Alison alludes, rest on the authority of Wilson Philip. The illustrious Müller directed his attention to the same branch of inquiry, and arrived at very different conclusions. After detailing the results which his researches established, he remarks: they "prove at least that, when the communication of the nerves with the brain is wholly cut off, they gradually lose the power of exciting the muscles to contraction, *while the muscles lose their irritability.*"* This property, however, continues for a considerable time after the section of the nerves.

CLV. Such are the objections which are advanced by the distinguished Professor against the doctrine, "that all muscular parts *derive a supply* of some kind of *influence or energy from the brain or spinal cord,* through the nerves which enables them to contract, or *renders them irritable.*" His arguments are not restricted to the presence of these organs, but to the existence of nervous matter.

A candid consideration of the previous observations can scarcely leave a doubt on the mind, that they break down in the critical analysis to which they are submitted. They are either based on assumptions, which have not the slightest degree of plausible evidence to recommend them to our notice, or are to be traced to misconceptions of the properties and functions of the nervous system.

He afterwards proceeds to show, that the other theory, *viz.*, "that muscles, although not actually drawing supplies of vital power through their nerves, are yet, *dependent on nerves for every occasion of the*

---

* Opus cit., p. 633.

exercise of that power," is equally without foundation.

CLVI. In reference to this theory, he says, "it appears a sufficient objection to state, that our only reason for supposing an intervention of nerves to be concerned in muscular contraction, is the excitation of that contraction by stimuli applied to nerves. But a conclusion which is rested on this fact, must be limited to the cases in which this fact holds good. Now there are *many muscles* (viz., all or almost all those that are destined to *involuntary motion* only), which, although exceedingly irritable, *are not excitable by mechanical irritation of their nerves.* We cannot, therefore," he remarks, "acquiesce in the proposition, that nerves furnish a condition essential to the irritation and vital action of muscles in general."

If he had said that there is a marked distinction between the voluntary and involuntary muscles, in regard to the facility with which their irritability can be excited by mechanical agents, he would have expressed himself correctly. The heart and the intestines, which come under the denomination of the latter class, have been shown by Humboldt, Burdach and Müller, to have their motions materially affected by irritating the cardiac nerves and the cœliac ganglion. Burdach "re-accelerated the action of the heart of a dead rabbit after it had begun to fail, by touching the sympathetic nerves with caustic potash or ammonia."*

---

* Müller Opus cit., pp. 190-1.

CLVII. All writers, in treating of the voluntary and involuntary muscles, dwell on the remarkable difference they exhibit, with respect to their susceptibility of mechanical and chemical agencies, which cannot be accounted for on any disproportionate amount of irritability possessed by them. The involuntary are admitted by Professor Alison to be "exceedingly irritable."

The true cause of the difference has not been suspected by any physiologist, nor has even a conjecture been advanced to explain it, except, perhaps, the supposed limited distribution of nerves to the involuntary muscles. It was never imagined that there was any peculiarity in the relations of the nerves to the two classes of muscles, which would satisfactorily elucidate the question.

CLVIII. The voluntary muscles, as of the trunk, the limbs, the larynx and of other organs, which are regulated in their movements by the will, *have all comparatively large and distinct nerves, which have such a relation to their structure that they are immediately brought into the required condition on the exercise of the mental power.* It is not a matter of speculation what nerves are instrumental in the production of the phenomena; nor are they so diminutive as to be traced with difficulty. They are of considerable size. It is then evident that they have extensive relations to the parts with which they are connected, or in other words, that they cannot be strongly aroused by mechanical or chemical irritation, without throwing many, and often, large muscles, into convulsive movements. According to this view, the accuracy of which is unquestionable, in acting on these nerves, in a variety of experiments, *we directly influence numerous muscles,* which (as long as they retain their natural irritability) are forced to respond to the stimulus by which they are excited *in consequence of their comprehensive structural associations with the nerves.* Therefore, supposing the artificial stimulus equal in all cases, the results arising from its action WILL BE PROPORTIONATE TO THE MAGNITUDE OF THE NERVES IRRITATED, AND THE NUMBER OR SIZE OF THE MUSCLES WITH WHICH THEY ARE DIRECTLY CONNECTED.

Here we have a clearly defined general law explanatory of the influence of the nervous on the muscular system, a just conception of which will be found fruitful in the elucidation of phenomena hitherto imperfectly understood, or, indeed regarded as inexplicable.

CLIX. We will now endeavour to ascertain in what manner a knowledge of this law will account for the greater difficulty experienced in irritating the involuntary muscles through their nerves, and the less striking results which follow compared with those occurring in the voluntary. Whether we examine the nerves distributed to the heart, the stomach, the intestines or the urinary bladder, we find conditions, in the relations of these nerves to their respective organs, as dissimilar from those observed in connexion with the voluntary muscles, as are the functions which the two

CLXI. The learned Professor, in concluding his remarks on the phenomena of the muscular system, observes: that "the essential difference of these classes of muscles seems to depend on the different endowments of the nerves entering them. And the final cause of all endowments bestowed on nerves in the living body, in relation to muscles, appears to be, *not to make muscles irritable, but to subject their irritability in different ways, to the dominion of the acts and feelings of the mind.*"*

The fallacies involved in this passage are of a grave character. The doctrines which it inculcates would be fatal to the sound and steady improvement of medical science. It displays a limited knowledge of the comprehensive functions of the nervous system. It teaches no great physiological truths capable of elucidating the conditions of health or disease. Though the voluntary and involuntary muscles have equally their motory nerves, and through them are susceptible of various influences by which their contractile properties are modified, effects which he admits; he, nevertheless, argues that the difference of these classes of muscles is to be ascribed *to the different endowments of their nerves.* Save that the one class is obedient to volition, is it philosophical to imagine that the same kind of motory nerves are not equally efficient in both? Have they not the same general connexions with the nervous centres, whence they draw the principle which diffuses its invigorating power throughout the animal economy? Are not the organs they supply similarly affected by the excited or depressed functional conditions of these centres? And yet, have the motory properties of the one class of nerves nothing in common with those of the other?

---

* His own italics.

Can the immense nervous matter associated with the heart, the stomach, the esophagus, the intestines, the uterus and the urinary bladder, have no functions in relation to their diversified movements, except to render them subservient, "*in different ways, to the dominion of the acts and feelings of the mind?*" Can this possibly be a just interpretation of the ends of nature in bestowing these nerves, and in establishing their comprehensive connexions with the nervous centres? An answer is given to these questions in the foregoing elaborate researches, and they will be further considered in the subsequent pages.

CLXII. We now propose to analyze the experiments and doctrines of Dr. Wilson Philip, which are constantly referred to in confirmation of prevailing physiological opinions. His authority stands high both at home and abroad. His work on the LAWS of the vital functions, displays great labour, ingenuity and talent, but is not equally distinguished by its logical perspicuity or any large principles tending to throw light on the origin and nature of diseases. His experiments and reasoning on the relations of the nervous to the muscular system, alone concern us on the present occasion. He had glimpses of great and important truths, but failed to perceive their widely pervading character. He regarded the nervous and galvanic influence as identical, and yet strange, he contends throughout his Treatise, that the nervous power acts only occasionally on the involuntary muscles, in fact that these are altogether independent of it.*

CLXIII. Almost the whole of his fallacies are to be traced to the unfortunate view which he took of the principles co-operating in the performance of the vital functions. It is the source of all his inconsistencies and constantly embarrassing refinements. From no writer is it so easy to select numerous facts that might be used with considerable cogency in opposition to his own conclusions. He states that the functions of life are carried on by three *distinct* powers, which he designates the sensorial, the nervous and the muscular. Of this division he speaks in the following terms. "The *nervous*, then, obeys the *sensorial* system, in the same way in which the *muscular* obeys the nervous system; but as the muscular power has an existence independent of the nervous, so has the nervous an existence independent of the sensorial power."† "It appears from the experiments which I have had occasion to relate or refer to, that in the more perfect animals there are three vital powers not directly depending on each other, the *sensorial*, the *nervous* and the *muscular* powers."‡ "The *nervous* power is not more distinct from the *muscular*, than it is from the

---

* An Experimental Inquiry into the Laws of the Vital Functions, page 264.

† Opus cit. p. 104. ‡ Ibid, p. 186.

sensorial power."* We are informed that the sensorial power resides in the brain, the nervous in the spinal cord, and the muscular in the muscles.

From such clear and definite language it would naturally be imagined, that we should have striking and appropriate illustrations of these distinct powers, but we are at once led into inextricable confusion. The moment we begin to luxuriate in the transparency of his views, and are all anxiety to trace their application, we are told, "that the *sensorial* power is not wholly confined to the brain, nor the nervous power to the spinal marrow, *both powers in a greater or less degree residing in both organs*."† "Nerves proceeding wholly from the brain exhibit all the phenomena of *nervous* power properly so called, and that the spinal marrow possesses *sensorial* power appears from very simple experiments." ‡ One of these very satisfactory experiments establishes the extraordinary fact, that the frog, some hours after it has lost its *head*, will often sit in its usual position, "and appears sensible to an injury inflicted on any part of it," muscular contractions taking place merely from reflex action. Such is the kind of evidence which he gives of the existence of sensorial power in the spinal cord.

He further remarks, that there is every reason to believe, "that the brain and spinal marrow are the only sources of nervous influence," and that as long as this exists in the nerves, the irritability of the muscles may be excited, and yet he contends with

---

* Opus cit., p. 266. † Ibid. p. 263. ‡ Ibid. p. 187.

Haller and his followers, that the muscles contract from a property which is inherent in them. On his own showing this is lost when they are deprived of the nervous agency. How is the *vis insita* to be established, if it is never manifested except in connexion with the animating principle of the nerves? He says that "this *muscular* power has an existence independent of the *nervous*," and yet the former is invariably annihilated on the loss of the latter.*

CLXIV. If in place of confusing his readers with his sensorial, nervous and muscular powers, he had regarded the entire animal system as pervaded by one principle, the source of all vital and mental actions, and had endeavoured to trace the modifications in its distribution, exciting or depressing the functions of life, how much more simple and comprehensive would have been his views! We should then not have had the sensorial power running into the regions of the nervous, nor the nervous into those of the sensorial, exercising the offices of each other; nor should we have had the importunate heart and the rest of the involuntary muscles, withdrawn from the constant participation in the current of the nervous influence.

CLXV. We will now turn to his experiments which are frequently appealed to in support of physiological doctrines, and see whether the analysis of them will be a more gratifying task than the examination of the conclusions to which they have led.

---

* Opus cit., p. 203.

"Exp. 32. All the nerves supplying one of the hind limbs of a frog were divided, so that it became completely paralytic. The skin was removed from the muscles of the leg, and salt sprinkled upon them, which being renewed from time to time, excited contractions in them for twelve minutes; at the end of this time they were found no farther capable of being excited. The corresponding muscles of the other limb, *in which the nerves were entire*, were similarly treated. They ceased to contract in ten minutes." In other experiments, he says, the difference in regard to time was greater. He draws the following conclusion: "From this experiment it is evident, that the nervous influence, so far from bestowing excitability on the muscles, exhausts it like other stimuli. The excitability, therefore, is a property of the muscle itself."*

Let us endeavour to analyze this celebrated experiment and determine its value. The conditions essential to its accuracy are of the highest importance and any deviation from them renders it of no worth. We have no evidence that they were scrupulously studied. We are told that the salt was *sprinkled*. The term would seem to imply no delicate calculation as to the *quantity* which was employed in either case. A difference in the amount or in the mode in which it was spread would entirely invalidate the results. On this point the writer does not make a remark. If the muscles of the one limb received a greater dose than those of the other, the effect would be proportionately more marked.

---

* Opus cit., pp 99, 100.

The physiologist, if not acutely sensible of the necessity of scrupulous attention to these points, would certainly not spare the sound limb, the object being specially to test the influence of its nerves on the irritability of the muscles.

There are other considerations suggested by the experiment which are not taken into account. The application of the salt to one limb would excite no sensations; in the other, where the nerves were entire, the feelings of the animal would be painful in the extreme, and the brain would have relations to this limb which it had not to the other, circumstances which might have a material effect on its nerves. Depressing passions weaken all vital functions whether of animal or organic life; and how far the natural conditions in the one case might influence the action of these nerves, it is impossible to ascertain.

In all such experiments, where extraordinary nicety and accuracy are required not only in reference to the means which are employed, but to the highly susceptible powers operated upon, which are certain to be disturbed by our interference, the physiologist seldom displays that knowledge of the nature of the vital field he proposes to cultivate,—or that solicitude to preserve in their normal state the phenomena crowding it, which is essential to give value to his researches. Almost nine-tenths of the experiments on living structures are unworthy of confidence, either from ignorance of or inattention to these matters.

CLXVI. If the nerves, according to his reasoning, exhaust the excitability of muscles, one would imagine to destroy them in a limb would be an excellent mode to maintain it in the fulness of its powers. If so far from imparting such property they expend it, the inference is inevitable. He states, however, that the irritability ceases when it is no longer furnished with nervous energy. "The muscle," he remarks, "will thus be made to contract as long as any influence remains in the nerve, but this being once exhausted, the nerve has no means of renewing it."* Here the muscle loses its excitability from the absence of the nervous influence; in the experiment it disappears from being exhausted by the same nervous influence, and not, it must be kept in mind, from the exertions of the limb which always materially affect the condition of nerves. How such an experiment proves the excitability of muscles to be an inherent property in them we are unable to discover.

The inconsistencies of this writer are extraordinary and can be appreciated only by an attentive perusal of his inquiry. In one place, the nervous influence is an essential stimulus to both classes of muscles; † in another, the involuntary are only *occasionally* excited by it.[*] Again, we are told that the muscles lose their contractility when the nervous influence is withdrawn;[†] yet he, nevertheless, repeatedly asserts that the muscular fibre does not in any "degree directly depend on the nervous power."[‡] If it has no dependence upon it, why does it cease to manifest the property of irritability when it is no longer supplied with it? *What phenomena does it exhibit apart from its association with the nervous influence?* According to his own admissions there are none.

---

* Opus cit., p. 203.

† "The functions of the nervous influence are those of stimulating the muscles both of voluntary and involuntary motion." —Page 220.

CLXVII. We now pass to the examination of an interesting class of experiments. He proceeds to show the effects produced on voluntary and involuntary muscles from mechanical and chemical stimuli applied to the brain and spinal cord. We can only afford space to allude to the results at which he arrived.

In passing a wire or any other instrument into the substance of the brain, or applying to it spirits of wine or a watery infusion of opium, the contractions of the heart were instantaneously excited; but no effect whatever was observed on the voluntary muscles. These were, however, convulsively affected when the wire touched the medulla oblongata from which the cerebral nerves arise. The impression on the heart, whatever means were employed, was always proportionate to the amount of nervous matter directly influenced whether of the brain or spinal cord. From this he inferred that the heart is subject not to any particular part of the cerebrum, but equally to the whole of it, and that this circumstance accounts for the regularity of its movements, which, though they might be accelerated or retarded in his experiments, never lost their natural *successive* character. He observes that the irregular action "of a voluntary muscle arises from stimuli acting *partially or at intervals* on its nerves, or on the particular part of the brain or spinal marrow from which its nerves arise."

---

[*] The voluntary muscles "are always excited by the nervous influence;" the involuntary, "though *occasionally* excited by this influence in all their functions obeying other stimuli."—Page 255.

[†] See passage immediately quoted above.

[‡] Page 219.

CLXVIII. These experiments, which are universally regarded as throwing great light on the functions of the nervous system, are a melancholy illustration not only on the part of the physiologist himself, but of the age, how imperfectly important conditions were understood which are essential to the soundness of the conclusions deduced from them. When the stimuli were applied to the brain they produced, he says, immediate and very obvious effects on the heart, *but none on the voluntary muscles.* Hence the inference that they have no effect on the latter. We shall show that they have necessarily an effect on every part of the animal economy.

CLXIX. When we attempt to measure the influence of any agent, especially in researches of this kind on different organs, it is an all-inportant circumstance to ascertain previously, how far the actions of the organs are alike; or, *how far the functions they perform will enable us to trace the effects of such influence.* We will endeavour to illustrate our meaning. If we had to estimate the value of a few particles of gold dust should we not have recourse to the most delicate scales, and not to those which determine the weight of substances of great bulk? And why? Because the one, from its exquisite adjustment, has a much higher degree of delicacy than the other. Should we be entitled to conclude, if the particles were placed in the latter that they would produce no effect? Certainly not. The effect would not be obvious, but it would be inevitable. Now the heart and the voluntary muscles are correctly represented by these instruments in reference to the influence of stimuli applied to the brain. THE HEART IS IN MOTION,—we perceive its successive contractions and can estimate the slightest change in their force or frequency: THE VOLUNTARY MUSCLES ARE AT REST, and we can detect no modification in their functions.

The contractions of the heart are the delicate scales which enable us to measure an amount of influence, of which the voluntary muscles give no evidence. It would, however, be unphilosophical to conclude that they are unaffected by it. The brain has the same general relations to every fibre of the animal system. It is the source of its vitality, and consequently to disturb the conditions of this important nervous centre is to derange the whole of its comprehensive relations.

The two cases are exceedingly dissimilar. The same impressions may be conveyed to the nerves of the voluntary and involuntary muscles, but from the striking difference in their functions they do not fall equally under observation. To render them obvious in the former it is necessary that they should be aroused to activity, to accomplish which a much more powerful stimulus is required than to modify the motions when they exist. The conclusions which are drawn from such experiments are unphilosophical in the extreme. The physiologist was not sensible of the remarkable difference in the nature of the objects which he attempted to influence. The brain has not a more intimate connexion with the heart than with the voluntary muscles, in respect of the general nervous relations by which all parts of the animal system are associated. The effect of emotions on the paralytic limb is an apt illustration of the truth.

CLXX. In his experiments Dr. Philip could not produce any *irregularity* in the contractions of the heart; while in stimulating the region whence the cerebral nerves arise, the motions of the voluntary muscles were always *irregular* and of a convulsive character.* The explanation which he gives of the phenomena displays an imperfect acquaintance with the laws regulating the action of these organs. He ascribes the continuance of the successive contractions of the heart, modified only in strength and frequency, to the supposed fact of being subject to every part of the brain and spinal cord. But why should we expect its movements to become irregular? In all the ordinary circumstances of life whether it be excited or depressed, they have generally their natural succession. Whether we impart to its nerves additional stimulus, or withdraw a portion of the principle by which they are animated, this is no sufficient reason to calculate on a result which he anticipated. *Its contractions are regularly successive because such are the laws of its organization.*

---

* "Exp. 39. I tried, in every possible way, both by mechanical and chemical stimuli, and both before and after the sensibility was destroyed, to excite, through the brain or spinal

CLXXI. On touching the origin of the cerebral nerves the actions of the voluntary muscles were always *irregular*, which he says is attributable to the "stimuli acting partially or at intervals on their nerves." What sort of motions in the voluntary muscles, when the animal is dead, would be considered regular? Would

---

marrow of rabbits and frogs, any *irregular* action in the heart which is so readily excited in the muscles of voluntary motion, but could not."—*Opus cit.*, *p.* 109.

"The heart being equally affected through all parts of it, (brain) must render it much less subject to irregular action; which may be one of the final causes of the heart, whose regular action is of such importance in the animal economy, being made subject to the whole, and not to any part of the brain."—*Opus cit.*, *p.* 117.

it be expected to walk, run, fly or swim? To what definite object could the motions tend, when the mental power by which they are controlled is destroyed, and cannot be imitated by probing with a wire the medulla oblongata or the spinal cord? The actions are irregular, not because the stimulus is either partial or applied at intervals, but from the simple reason *that it is impossible they should be otherwise.*

CLXXII. These convulsive motions can be excited in the living and healthy body without any cruel or torturing operations; without deranging the structure of a single animal fibre, and by acting on the *surface* of the brain, to which the application of stimuli in his experiments failed to elicit any result on the voluntary muscles. The power by which such effects can be produced, is mesmerism; and they are far greater and much more varied than those arising from mechanical or chemical irritation of the nervous masses. The fact and its accompanying explanation will be found in our recent work.*

CLXXIII. Though Dr. Philip observes the extensive relations which the heart possesses to the brain and spinal cord, and its extraordinary susceptibility in regard to all stimuli applied to these organs, he, nevertheless, argues that the nervous influence is not in any degree instrumental to its motions: and although the voluntary muscles are thrown into convulsive action whenever the origin of their nerves is irritated, so instantaneously as to present the appearance of a galvanic shock, yet he says these muscles are likewise independent of the nervous system.*

---

* Philosophy of animated Nature, &c.

CLXXIV. These conclusions, when we take into consideration the experiments by which they are imagined to be established, would be strange and inexplicable in any writer; but more especially are they when enforced by one who regarded the nervous and galvanic agency as identical. This enterprising physiologist was upon the threshold of important discoveries;—a brilliant and unequalled prospect of boundless truths was just opening upon his mind; but which he failed to secure from his mystifying and perplexing distinctions between the sensorial, the nervous and muscular powers. They limited and distorted his views.

CLXXV. We shall allude only to one more of the fallacies which pervade his work, but which is of a serious character, and so perfectly illogical, that it is difficult to conceive how the opinion could possibly be entertained. He remarks that the nervous influence is capable of both *exciting* and *depressing* all vital functions. This is not in reference to the agency of the mind, the various conditions of which may produce either of these results; but, in this case the depression could not with propriety be ascribed to any peculiar qualities possessed by the nervous principle. The *plus* and *minus* of its different states will explain the phenomena.

---

* "It not only appears from the experiments which have been laid before the reader, that the power of the heart and vessels of circulation is independent of the nervous system, but that of the muscles of voluntary motion is so likewise."—Page 119.

On crushing the head of a rabbit, or in otherwise injuring the nervous masses, if the contractions of the heart were enfeebled, he immediately adduces the circumstance as an illustration of the depressing effects of the nervous influence. How the experiment proves it we are at a loss to conjecture. He shows the extensive relations existing between the heart and the brain, and if we suppose, which is the fact, simply to give clearness to our reasoning as well as to expose the errors of his own, that the heart derives from the brain and spinal cord the nervous fluid by which it maintains its series of contractions, would not the *crushing* of the head be the *subtraction* of one source of its power, and, from the nature of the experiment, be well calculated to produce a strong impression upon it. It is irrational in the extreme to bring forward such results in support of the depressing influence of the nervous agent. It is the essential stimulus of all vital functions throughout the vast range of animal creation.

CLXXVI. One of the latest and most copious writers on the nervous system, is Dr. Marshall Hall. He is deserving of credit for the industry he has displayed in showing the application of the doctrine of Prochaska concerning the reflex functions of the spinal cord to the elucidation of various interesting nervous phenomena. He does not, however, exhibit, in any part of his productions, a just conception of the nature or comprehensive character of the views which he has laboured to establish. His understanding is deficient in a philosophical power of generalization. His perseverance enables him to collect together numerous particulars, but he rarely perceives their value and extensive relations. He presents no finished pictures—no large or clearly drawn principles tending to explain the origin or treatment of diseases. Indeed, it would be difficult to find in his researches concerning the nervous system, any observations that can be shown to throw a steady light on the causes of its frequent derangements, or to suggest any remedies applicable to their correction.

CLXXVII. We will endeavour by an analysis of his views to substantiate the justness of these remarks. They have, in two important respects, a striking analogy to those of Dr. Wilson Philip, in fact it is largely the same doctrine, and the influence thus operating on his investigations is equally detrimental to the establishment of sound general principles. In his hands it is disfigured by fewer inconsistencies. Dr. Wilson Philip divides the vital functions into sensorial, nervous and muscular. The sensorial are seated in the brain, the nervous in the spinal cord, the muscular in the muscles. Dr. Hall adopts the two first under somewhat different terms. The brain is spoken of as the seat of sensorial or psychical phenomena; the spinal marrow as the seat of the *vis nervosa* of Haller, which is the nervous influence of physiologists. He labours to show that the actions exercised by these two nervous masses are very dissimilar, which required no argument to prove.

He not only states that these actions are widely different in their character, but repeatedly asserts throughout his work, that the animating power of the cerebral system has nothing in common with that of the true spinal; or, in other words, that the agent which pervades the brain and enables it to manifest its peculiar properties, is altogether different from that which vivifies the functions of the spinal cord. Indeed, he warms into eloquence, as the following passage shows, in insisting on these distinctions: "The *principle* of action in the cerebral system is the ψυχη, or the immortal soul. Upon the cerebrum the soul sits enthroned, receiving the ambassadors, as it were, from without, along the sentient nerves; deliberating and willing; and sending forth its emissaries and plenipotentiaries, which convey its sovereign mandates, along the voluntary nerves, to muscles subdued to volition."*

He further remarks, "the olfactory, the optic, the acoustic nerves are, equally with the cerebrum and cerebellum, incapable of pain or of *exciting movements* in the muscular system, when punctured or lacerated. They are, as I have stated and re-stated, the *seat* of the sentient principle—the soul; but they are not sentient themselves; and they are not endowed with the excito-motory principle."†

---

* "On the diseases and derangements of the Nervous System," by Marshall Hall, M.D., F.R.S., p. 3.

† Opus cit., p. 30.

In these inquiries we do not presume to argue the question of materiality. We have no light to throw upon the subject. Our business is to study the phenomena of life as they present themselves in connexion with organization; to trace, as far as circumstances will permit, their sources and the causes by which they are modified in health and disease.

CLXXVIII. The limited sphere within which the writer confines the nervous influence, is the origin of nearly all his fallacies, his imperfect views and illogical reasoning. It is impossible for the understanding investigating the vital phenomena in such circumscribed conditions, to attain any height that will give to it a wide range of observation. The attempt to carry out the distinctions leads to an almost inextricable mass of confused ideas, which is strikingly apparent when he endeavours to explain the reciprocal action between the cerebral and spinal systems, the principle of the one having nothing in common with that of the other. Dr. Wilson Philip allowed that the sensorial and nervous powers occasionally trespassed on the precincts of each other,—a privilege which his indefatigable successor does not grant. He restricts them to their legitimate regions, and hence the difficulties which beset every step of his researches.

CLXXIX. The distinctions which he makes between the sensorial and spinal systems, affect, also, his views in regard to the agency of the *vis nervosa* itself. He clearly has no just conception of its vast sphere of duties, or of the laws by which these are regulated, as the following passage indisputably indicates. "The *vis nervosa* is, I believe, demonstrably the source of the excited reflex actions and functions. The same power is *probably*, in its direct or immediate influence, the source of the movements of the internal organs—the heart, the stomach, the intestines, &c.; the organs of secretion, of nutrition, &c."*

This is not the language of one who has a comprehensive insight into the operations of the nervous influence, its sources and modes of distribution, or of the causes by which it is modified in the ever variable living structures. He had studied the reflex actions in confined points of view until he could see little beyond them. They had one effect on his mind: they awakened his imagination to conjecture, what he ought to have seen were the necessary consequences of his own principles, had he understood their bearing.

CLXXX. He constantly observes that the brain, in its acts of volition, is an *exhauster* of the irritability of the muscles. Is it not familiar to every one that severe and long continued mental application deteriorates the tone and vigour of every part of the body; and that protracted muscular exertion enfeebles the energies of the mind? What does the mind and the muscles, in these cases, exhaust? Does the brain expend that which has nothing in common with the *vis nervosa*, and yet the loss of that which is peculiar to itself should produce these effects? Do the muscles likewise allow a *something* to escape in their violent or persistent actions, which is widely different from the principle which excites and maintains the sensorial functions, and yet these, *from the expenditure of a power on which they had not the slightest dependence or relation to*, are incapacitated for the vigorous performance of their offices? How beautifully simple is the explanation of these phenomena when we consider that one animating agent pervades the entire nervous system; and, therefore, that the expenditure of it, in any direction, whether through the brain or muscles, is a loss to the whole of such system and will affect the instruments of life according to their susceptibility.

---

* Opus cit , p. 122.

CLXXXI. The analysis of his remarks on sleep presents a rich field for investigation, and will tend to show how futile and unphilosophical are the distinctions which he has laboured to establish between the principle of action in the cerebral and spinal systems. He observes, "*As the true spinal system does not sleep*, so it is incapable of fatigue; and it is on this principle, I believe, not only that respiration is unattended by fatigue (except in cases of dyspnœa, or otherwise, when our *attention* is directed particularly to it, and it becomes greatly a voluntary act), but that the long flight of birds in their migrations, and of flies which are all the day long on the wing, is sustained."*

---

* Opus cit., p. 26.

"During *sleep*, the cerebral functions are in a state of repose, but the true spinal functions continue in activity and energy."*

Sleep, as a state of repose, is not confined to the brain, if by the term is understood the cessation or suspended *activity* of functions, which is an accurate definition of the phenomenon. The voluntary muscular motions of the body, active and varied during the day, are accompanied with a waste of nervous energy which is derived from the brain, the medulla oblongata and the spinal marrow. They are all sources of it, and it flows from each according to the nature and extent of the vital actions. They are so connected that it is not possible to make a large demand upon one without affecting the conditions of the rest. This must clearly be the case if one principle vivifies the whole.

The inordinate demands of the muscular system being suspended, it is evident that *the sources whence the nervous fluid is derived, are, in respect of the organs which were the outlets for its escape, in a state of repose.* It does not follow from this doctrine that they shall not continue to supply the current required for existing vital operations. Sleep is for the purpose of facilitating it in a way that none have justly apprehended.

CLXXXII. The toils, the duties and the necessary functions of life, and the varied amusements and pleasures of the busy waking hours, excited by circumstances ordained to develope and exercise the faculties of the animated being, *create nervous relations which are in harmony with these conditions.* These may be characterized as establishing extensive *external* relations; and the nerves by which they are maintained having only a certain amount of the nervous principle to draw upon, the time, at length, arrives when nature intimates that the demands in such diversified directions must be arrested, and sleep, as an essential consequence, brings its sweet and refreshing influence.

---

* Opus cit., p. 202.

CLXXXIII. With the darkness and deep silence of night the nervous system gradually conforms to new conditions. The senses have shut out the external world,—the mind has laid aside its anxieties and restless schemes of ambition,—the muscles of voluntary motion are at rest,—the body is in the recumbent position, and everything indicates the luxury of repose. The nervous fluid, lately so active and occupying so large a surface in regard to external objects, is now drawn within a narrower sphere. With the cessation of animal life, begins the uninterrupted play of the functions of the organic, or in other words, nature freed from her *external* engagements collects her scattered forces and directs them upon the internal organs generally. These undisturbed in their operations and circumscribed in their range of action, acquire fresh powers, and a new balance of the vital energies is the result. The nervous centres have now relations to these *internal* organs. The reciprocal influence which the one class exercises upon the other, neither making an inordinate demand, continues through the unconscious hours of slumber until at last the process of restoration is completed, the brain, the spinal cord and their numerous nerves have recovered their lost tone, and have accumulated an amount of the nervous principle equal to the exigencies of the coming day, and with the dawn enter upon their routine of reiterated duties.

CLXXXIV. If this be a correct description of the changes which distinguish the activity and repose of the nervous system, with what propriety can the latter be regarded as implying only the cessation of the cerebral functions? The enunciation of such a doctrine is evidence of the limited views of the physiologist on this highly interesting subject. How inadequate are his psychical principle and his *vis nervosa* to explain these varied nervous conditions!

CLXXXV. He observes, that "as the true spinal system does not sleep, so it is *incapable* of fatigue," and in illustration of this opinion, he alludes to the long flight of birds in their migrations, to flies which are all the day long on the wing, and to the uninterrupted successive acts of respiration. It is impossible that any organ should be incapable of fatigue even if it be the seat of a purely vegetative function. If by fatigue is understood exhaustion, the spinal system is no exception to the general rule. Had he appreciated the distinctions pointed out in the preceding remarks between the activity of the brain and spinal cord in their comprehensive *external* relations, and the character of their activity in the subsequent *internal* relations, as exemplified in sleep, he would have reasoned very differently on the muscular and mental phenomena in the instances to which he refers.

The cerebrum, properly speaking, does not sleep. Certain of its faculties may be susceptible of it. They are endowments by which it holds converse with the external world, but when they are lulled into unconscious slumber, it continues to distribute the nervous principle and is as incapable of repose as is the heart itself. The same may also be said of the spinal cord. In studying the cerebral functions, we must not confound the manifestation of mental acts, and the exercise of nervous properties in relation to the vast sphere of organic and involuntary operations. The brain is as essential to these in the hours of sleep as in their highest state of excitement. We know that it is liable to fatigue as well as the true spinal system; but IT IS FATIGUE IN RELATION ONLY TO PARTICULAR FUNCTIONS. The intellectual faculties are wearied by great application: the voluntary muscles grow feeble from violent exertion. The cause is the same in both cases. In correct philosophical language neither the faculties nor the muscles are in fault, BUT THE NERVOUS CENTRES WHENCE THEY DRAW THE NERVOUS POWER. These fail to furnish the stream essential to their active conditions, consequently in relation to these they are fatigued and exhausted. But on what grounds are we to conclude that they are not equal to, or in fact do not co-operate in other remaining functions?

CLXXXVI. Dr. Hall labours to establish an important distinction between the seat of sensation, volition and emotion. The two former he says, exist "in the cerebrum and its prolongations; emotion in the true spinal and the ganglionic systems."* He has been led to this conclusion from observing that "not only does emotion remain in the hemiplegic limb when sensation and volition are severed from it, but that emotion exerts its influence precisely upon those muscular organs which are under the influence of the *vis nervosa*, or excito-motory power; viz., the orifices and sphincters, the agents of ingestion and egestion; and as the *vis nervosa* acts *directly* upon certain internal organs, as well as *reflectively* upon those just mentioned, so we find the heart, the intestinal canal, the organs of secretion, &c., especially under the influence of emotion."† In further confirmation of his reasoning, he remarks: "Thus, too, the hemiplegic arm, paralyzed to volition, is moved and agitated by every emotion."

This doctrine has a striking analogy to the one which placed the passions in the different viscera, and was imagined by distinguished physiologists to be established by the fact, that these are disturbed by all violent emotions. He, also, argues from similar results, that they are seated in the true spinal and ganglionic systems. This view is equally unphilosophical.

---

* Opus cit., p. 257.

† Ibid, p. 256.

Sensation, volition and emotion, may possibly occupy different cerebral organs, but it is exceedingly irrational to separate the last from the brain. He was led to adopt this course from the distinction which he draws between the psychical principle and the *vis nervosa.* The former, according to his reasoning, belongs exclusively to the cerebral system and presides over the mental powers, and is altogether excluded from any direct co-operation in organic and involuntary actions. When, therefore, a limb, deprived of sensation and motion, was observed to be agitated by the strong feelings of the mind; and when the viscera presented likewise certain unequivocal effects, as the brain, from the definition of its functions, could not possibly exercise any such influence, he was necessarily forced to place the seat of emotion in his true spinal and ganglionic systems. The explanation of the phenomena will exhibit the viciousness of his classification.

CLXXXVII. The nervous centres and their numerous nerves are inseparably connected not only through the medium of nervous structure, but, also, by a principle which is common to the whole. The changes of which this is susceptible will satisfactorily account for the diversified effects arising from passion. When the limb no longer obeys volition and is destitute of all sensation, *it has not lost its comprehensive nervous* *relations to the brain.* The nerves, which were the channels of the will and of sensation, still exist, though no longer exercising their ordinary functions. Emotion is an extraordinary aroused condition of the nervous properties of the brain, AND IT IS THIS CONDITION WHICH ESTABLISHES THE MOMENTARY RELATIONS WITH THE VOLUNTARY NERVES. A stimulus is imparted to these of which they were previously not sensible. Not, however, to these only, but inevitably to every part of the nervous system. The eye has additional fire,—the countenance is animated,—the position or motions of the body are modified,—the heart struggles to perform its functions or contracts with increased force,—circumstances which clearly show that the energies of the cerebrum are awakened to more vigorous duties, or in other words, that the nervous principle has acquired a higher degree of activity in relation to the nervous system generally. The trembling or agitation of the limb, is occasioned by this stimulus acting on its voluntary nerves. The muscular movements were formerly excited and regulated by volition through them; not, however, independently of the nervous principle, but by means of its co-operation. The will is lost, *but the nerves remain and thus occasionally receive the impulses of emotion.*

This subject has, also, excited an interest in others, as the following passage from two able writers shows: "Mental emotions probably affect some part of the brain: if the only communication between the brain and the limbs be by the fibres of sensation and volition, it is impossible to understand how, in such a case, the emotional influence could be conveyed through a channel which has long been stopped. If we are to adopt Dr. Hall's theory, it will be necessary to suppose, with Dr. Carpenter, the existence of certain *emotional* fibres to explain the phenomena in this case. But it is difficult to admit the existence of three orders of fibres in each muscle, which to be effective, must have the same relation to the component elements of the muscle. It is impossible to imagine how each order of fibre should comport itself with reference to the other two, so that their actions may not interfere."*

CLXXXVIII. The classification which deprives the brain of nervous properties common to the rest of the nervous system, is the source of the fallacies of Dr. Hall on this and various other physiological inquiries. Of what use is his psychical principle in the explanation of these effects, or, indeed his *vis nervosa* which is strictly confined to the spinal and ganglionic systems?

CLXXXIX. The views which are here developed will elucidate other nervous phenomena the nature of which is not understood. He remarks, "it is well known that the irregular movements in chorea and in incipient paralysis agitans subside during sleep. I was long perplexed to account for this fact. It was only by observing that these movements subside during *quiet* sleep only, and return during the agitation of *dreaming*, that I perceived that it is not *sleep*, but the absence of emotion, to which this effect is to be ascribed. Dreams during sleep have the same effect as emotion in our waking hours. In regard to stammering, I believe it would scarcely exist without emotion; it is certainly exasperated in a tenfold degree by every cause of emotion, and it is mitigated precisely in proportion to the mental quiet, composure and self-possession of the patient."*

---

* The Physiological Anatomy and Physiology of Man. Vol. I. p. 324. By Robert Bentley Todd, M.D., F.R.S., and William Bowman, F.R.S. This is a valuable work, and contains many original and just views.

It is not possible to adduce any phenomena which are more opposed to his own doctrine, or more directly in confirmation of our own than these to which he alludes. In chorea and paralysis agitans, volition is unequal to the restraining of the muscular actions which these display. The attempt in the former disease, is often characterized by the strangest contortions of the body. Dreams are unquestionably seated in the cerebral system. They are the manifestation of its faculties exempt from the controlling agency of the will. He admits that they exercise the same disturbing influence as emotion does during our waking hours. We have, therefore, the BRAIN in its *dreaming* state exhibiting the same relations to the voluntary muscular apparatus, as is indicated by the excited feelings of the mind.

---

* Opus cit., p. 262.

To have been perfectly consistent and logical in his argument, he ought to have shown that the *psychical* principle was equally capable with emotion of producing these effects, because dreams are clearly psychical phenomena, and, according to his own reasoning belong exclusively to the cerebral system. He makes, however, no reference to this principle, but, as an accurate observer of nature, shows that such are the consequences which flow from this condition of the brain. A little reflection ought to have awakened a suspicion as to the justness of his distinctions.

CXC. The unsteady movements in chorea during the day are connected with the general activity of the cerebrum, excited by a variety of circumstances. These *movements are, therefore, in relation to this state of the cerebral system.* Its activity is clearly unfavourable either to the repose or normal exercise of the muscles. What are dreams? Are they not trains of thought differing only from those of our waking hours by the absence of volition? We should expect, antecedently to all evidence, that if the one condition of the brain occasioned and aggravated the irregular muscular contractions, the other, saving any difference in the degree of activity, ought to be equally efficient; and such is the fact. We cannot conceive a more beautiful illustration of the truth of these views than what is furnished by dreams in their relation to the muscular system. They display, in an exquisite manner, the widely pervading connexions of the brain with the animal economy when wrapt in unconscious slumber. The nervous properties, of which it is the source and distributor, are no sooner awakened to a larger sphere of operations, than they manifest these connexions by the phenomena which are consequent on their exercise.

CXCI. He has some curious remarks on the effects of volition in hemiplegia and chorea, which are easily explicable on the preceding principles, but certainly not on his own. "Let us next consider," he observes, "what occurs in some affections of the true spinal marrow: in one patient a *pen* could be grasped and held in its proper position for a moment or two by a strong effort of volition; *but this was speedily overcome by the more energetic influence of the vis nervosa,* and the pen could be retained in its proper position no longer."* In a youth, whose left arm was affected "with continual rapid spasmodic movements, the limb could be kept perfectly still for several minutes by a continual energetic act of volition. In this case, the influence of volition, antagonized and controlled that of the *vis nervosa*."† Again he remarks: "In cases of anæsthesia, the patient cannot retain a cup between his fingers safely, unless he keep his eye steadily fixed upon the object and grasp, *so as to supply by vision the loss of the sense of touch,* the usual and essential prompter of the acts of volition."‡

---

* Opus cit., p. 256. † Ibid cit., p. 263. ‡ Ibid p. 255.

He clearly has no just conception of the cause of these phenomena. In one instance, the pen, at length, cannot be held from "*the more* energetic influence of the *vis nervosa*." In another, this *vis nervosa* is antagonized and controlled by the will. In the third, the cup is grasped as long as vision supplies the loss of the sense of touch. What is the faculty of volition, but a state of the mind by which certain acts are willed and performed? We can walk or sit still. We can extend the arm or withdraw it. We can give to the muscles additional energy by which extraordinary feats of strength can be accomplished. Volition is a mental power in relation to the nervous system, not only operating *through* the nerves of voluntary motion, BUT REGULATING THE DISTRIBUTION OF THAT PRINCIPLE BY WHICH THEY ARE ANIMATED. It exists in the nerves previous to the will being called into action. This may increase the nervous current and modify its course, but there ends its agency.

It is unphilosophical to speak of volition being overcome by the energetic influence of the *vis nervosa*. Volition ceases, because it is a mental effort which cannot be sustained, and is always at the expense of the very *vis nervosa* which he says prevents its longer continuance.

CXCII. Why is the exercise of it in chorea and the cases to which he alludes, so inefficient and of short duration? If the *vis nervosa* overcomes its action, the presence of this power must be unfavourable to its operation. He speaks of the will as antagonistic to it. The pen is held, under ordinary circumstances, from the facility with which volition controls the nervous current brought into play by the muscular act, and its influence gradually declines with the waste or exhaustion of the stream. The will cannot steady or guide the muscular motions in chorea, not from any deterioration in its own power, but from the nerves on which it has to act not having the necessary amount of the nervous fluid to receive its impulses as in health; the normal relations between the muscles and the brain no longer existing.

Vision does supply the loss of the sense of touch, but not in the way he supposes. The looking intently at an object which is grasped, excites the cerebrum to greater activity, *and the energies aroused are placed more directly in relation to the hand.* To withdraw the agency of sight, is to allow the brain to fall into its relaxed condition. The additional strength which vision is instrumental in imparting, arises from invigorating the nervous connexions between the cerebrum and the parts which are in exercise.

CXCIII. We have, in a previous work, entered somewhat at length into the mode in which the senses affect the motion or expression of muscles by awakening the nervous properties of the brain, and the present case strikingly confirms our views. But how futile must all attempts necessarily be to explain such effects, unless we admit that the whole nervous system is pervaded by one common agent. To withdraw the brain from all participation in it, may furnish an occasion for the display of eloquence and laboured ingenuity, but clearly will be inadequate to the establishment of important practical truths. The evidence of the justness of this remark, is found in the several treatises of Dr. Hall on the nervous functions. Though we have studied them with care, and with an anxiety to be instructed on the nature and treatment of nervous diseases, we have in vain sought for principles that throw any new light upon either. This is not extraordinary. His doctrines are incapable of extensive application. They do not give to the mind a commanding position, so as to enable it to survey a variety of phenomena in relation to each other or the causes by which are produced or modified.

CXCIV. He alludes to another nervous affection, *viz.*, stammering, and describes its symptoms accurately, but not the causes of them. It is scarcely necessary to remark, that a variety of hypotheses have been proposed to explain it, or that numerous measures have been suggested to remedy the disease. The views which we shall offer will elucidate the phenomena which accompany it, and will show not only on what grounds the principles of treatment should proceed, but the reason why different plans have frequently been attended with success. In certain cases, it may depend on the abnormal constitution of the vocal organs, but these we may leave altogether out of consideration as they are the exceptions to the general rule.

Dr. Hall attempts to explain the various forms of stammering "on the principles of the physiology of the articulation of the different orders of letters."[*] At the conclusion of his article he puts several pertinent questions. "I may further ask," he says, "What is the state and position of the uvula in articulation? The velum and, with it, the uvula are elevated and placed so as to close the posterior nares, whenever certain letters are pronounced. Are incident nerves, regulators of articulation, excited in the case? And are they unduly excited in stammering? And is stammering not only an undue *spinal* action (as I stated many years ago) but an undue reflex spinal action? These interesting questions time and long investigation can alone determine."[†] According to the illustrious Müller, "the essential cause of the impediment is always situated in the glottis, whether it be that the vocal cords do not give the requisite sound when it is a vowel which is attempted to be formed, or that the passage of air is arrested during the attempt at articulation in the mouth. The essential cause of stammering, is, therefore, clearly an unnatural associate movement in the larynx by consent with the movements of the mouth, or articulate movements." He further observes, "I agree entirely with Dr. Arnott and Schulthess in considering the immediate cause of stammering *to be a spasmodic* affection of the glottis."*

---

[*] Opus cit., p. 191.

[†] Ibid p. 195.

CXCV. Stammering is unquestionably such a state of the vocal organs as is most aptly designated by the term spasmodic, *and depends on the disturbed nervous relations between them and the brain.* It is most important to make a distinction between the cause and the effect in this instance, as a just appreciation of it is essential to the philosophical treatment of the affection.

CXCVI. This frequently exists from the earliest use of speech, but is, also, often acquired subsequently by associating with those who labour under the defect; or it may arise from various causes both mental and bodily. It is, however, in all cases, to be traced to the condition of the cerebrum which is directly instrumental to articulation. In other words, *it is a mental affection.* We have shown† that all actions, whether voluntary or involuntary, as exhibited in the motions of the arm or the contractions of the heart, are successive, or distinguished by periods of interruption necessary to the supply of the nervous fluid expended in these acts. Any circumstance disturbing these relations between the brain and its nerves, will give rise to corresponding modifications in the character of the phenomena. The contractions of the heart may become irregular, —the respiratory movements may be retarded or otherwise disordered, and these conditions may become permanent. This is exemplified in stammering. Here the nerves, connecting the vocal organs and the brain, are peculiarly marked by a derangement of the laws which usually preside over their functions. The moment that an attempt is made to give utterance to the thoughts, the instruments of speech do not respond naturally to the will. They fail either in the pronunciation of a vowel or a consonant. Some writers assert that the difficulty is felt only in the endeavour to articulate the former. This is by no means a general rule; nor is the distinction of any great practical importance, the cause of the impediment and the mode for its correction being the same in both instances.

---

* Opus cit., p. 1056. † Philosophy of animated Nature.

CXCVII. The spasmodic action of the vocal organs, manifested in a remarkable degree when the individual is most anxious to express his feelings, arises from the disturbance of the relations between their nerves and the brain, increased by the mental excitement from the aggravated disorder induced in the nervous conditions.

In the previous inquiries it is shown that a strong emotion is capable of agitating the paralytic limb, from exciting these conditions, the awakening influence of which is communicated to the voluntary nerves though no longer subject to the will. Emotion produces a corresponding result in regard to stammering. The nervous cerebral properties are aroused by it, but are no longer obedient to volition, *and hence the spasmodic character of the effects on the organs of* *speech.* The composure of the mind facilitates the expression of the thoughts, by removing or preventing this undue activity of the brain.

CXCVIII. Peculiar changes take place in the character of the articulation in intoxication and the slighter degrees of inebriation. In the former, stammering is a frequent occurrence, and is in direct confimation of these views. The nervous excitement disturbs the ordinary connexions between the cerebrum and the vocal nerves, and the exercise of volition is no longer efficient in directing the nervous current. The attempt which it makes only augments the evil. We have known instances, in persons, just removed from the lower classes, under these circumstances, speaking in the refined tones of the highly educated or well-bred orders of society, which, at other times, they were incapable of imitating.

CXCIX. It is stated that the excision of the uvula or tonsils, will frequently cure inveterate cases of stammering. This may be an occasional result, though the operation is certainly not necessary for the judicious treatment of the affection. The fact, however, presents no difficulties. These organs, though not necessary to speech, are brought into play by the efforts of articulation, and if elongated or enlarged, may tend, in an important degree, to aggravate the effects of the spasmodic action. It is, perhaps, only in this manner that their influence can be detrimental. Dr. Hall remarks, that if the relief, arising from the experiment, prove to be well founded, "a new ray of light will be thrown on this singular malady. Is the uvula the exitor-regulator of articulation? Is it in cases of stammering unduly excitable?"* The new ray of light according to his reasoning would not elucidate the phenomena of the disease. The study of it, in relation to the views which are here developed, is not indeed without interest or value.

cc. The various methods which have been recommended for the treatment of the disease, and all, whether suggested by philosophical or empirical considerations, that have been attended by any degree of success, have been beneficial on one general principle, though this was little conjectured by their ingenious expounders. Whether the plan be raising the tongue towards the palate, the placing of bodies under it; or guarding against the closure of the glottis by the sustained intonation of the voice through a series of words; or prolonging the pronunciation of certain letters; these, and all other rules, have *a direct reference to the mind.* While the anxiety was to regulate the movements of the vocal organs, as the seat of the affection, the real and substantial remedy, unsuspected in the enforcement of the different practices, was applied to the correction of that condition of the brain which is alone the cause of it. Whether importance be attached to the position of the tongue, or pebbles be introduced into the mouth as efficient agents, the basis of all improvement was the slowness of pronunciation. By directing the attention to the *imagined* source of the impediment, a remedy was applied immediately to the evil in its very origin,—*the disturbed relations existing between the cerebrum and the vocal nerves.* In this, and all other instances, whatever be the character of the nervous affection, whether accompanied with a modification of the voluntary or involuntary organs, it is to be traced to the altered distribution or impeded action of the nervous principle.

---

* Opus cit., p. 194.

CCI. Stammering is occasionally produced by the derangement of the bowels, and is cured by purgatives. This is another illustration of the soundness of the views which are here presented. In this case, we have clearly not to analyze the peculiar state of the vocal apparatus as a cause of the hesitation. The disorder obviously excites a condition of the brain which is unfavourable to the supply of the nervous fluid to the instruments of articulation. A fact of this kind does really throw light on the nature of the malady.

It is often remarked in persons who stammer, that, when they unsuccessfully struggle to convey their sentiments, the feelings rise at length to the highest pitch of emotion, and find a ready utterance in oaths, and that afterwards they are able to continue the conversation with their ordinary facility This is an interesting phenomenon. The lesser degrees of the emotion are embarrassing from being associated with a greater diversity of intellectual operations. The reasoning powers are in full play, and the mind is anxious to express a series of consecutive thoughts; but when the mental efforts are powerfully concentrated by the aroused passion, the nervous principle is no longer interrupted in its course to the vocal organs. The instances of this kind, which have fallen under our observation, have not presented the affection in its most aggravated form.

CCII. We pass now to the examination of some other doctrines of Dr. Hall, and shall endeavour to expose the extraordinary fallacies by which they are pervaded. The analysis of them will exhibit the importance of distinctions, in reference to the conditions of the muscles, which have not prominently suggested themselves to the physiologist. The inquiry demands more than ordinary attention to seize fully the essential differences which will be brought under consideration. The value of the facts which will be established, is not limited by the correction of the errors of this writer. It has a comprehensive bearing on the powers of life generally, and equally on the nature and treatment of diseases.

It is clearly shown by the experiments of Müller, that when a large nerve in a limb is divided, this after some time loses its excitability, and the irritability of the muscles is no longer manifested on the application of a mechanical or chemical stimulus. These results are placed beyond all doubt by a series of simple and well conducted researches. He was led to these investigations by the previous experiments of

Nysten, who asserted that in persons who died of an apoplectic seizure, the muscles displayed after death considerable irritability, and contracted under the influence of galvanism, though "the brain had been paralyzed."* It was, also, proved by Legallois, that the same property remained in rabbits, and was manifested for a very long time whenever the sciatic nerves were irritated, though the spinal marrow had been entirely destroyed.

CCIII. On these different experiments Dr. Hall remarks, "these statements appear, then, sufficiently opposed to each other; how shall we explain or reconcile them?"† The experiments are not strictly opposed to each other. To entertain such an opinion shows in what an imperfect light they had been viewed. The conclusions at which Nysten arrived have been corroborated by many subsequent inquirers. Though the power of motion, in such cases, is annihilated, the limbs have an uninterrupted connexion with the spinal cord. In the experiments of the illustrious Müller, the limb was not only separated from the brain, but from the other great centre of nervous energy,—the spinal marrow, and then, after a considerable period, the nerves were found to have lost their excitability and the muscles their irritability. The experiments were widely dissimilar in character, and each established its own legitimate truths.

---

* Müller, Opus cit., p. 632.

† Opus cit., p. 211.

CCIV. To endeavour to elucidate the supposed discrepancies, Dr. Hall has recourse to the interesting effects observed on the human frame from the administration of strychnine. As a general rule, when this powerful agent begins to exert its influence, the paralytic is perceived to be more affected than the sound limb, a fact which has given rise to various speculations. This indefatigable writer, at once, imagined that here was the light to guide him in the solution of the difficulties. He asks, is the irritability of the muscular fibre, in such instances, "*actually augmented?*" After waiting some time for an opportunity of testing the accuracy of his conjecture, one at length presented itself, and he says "the result was as I anticipated. A little child, aged two years, was perfectly paralytic of the left arm. The slightest shock of galvanism was directed to be applied which should produce an obvious effect. It was uniformly observed that the paralytic limb was agitated by a degree of galvanic energy which produced no effect on the healthy limb."* Other cases of a similar kind are given, which it is unnecessary to relate. Sometimes both limbs were agitated, but the paralytic one always more than the other.

He attempted to establish the fact by other experiments. He divided the spinal marrow immediately below the origin of the brachial flexus. The posterior extremities were of course paralyzed to voluntary motion. He separated the right posterior extremity from its connexion with the spinal cord, by removing a portion of the ischiatic nerve, while the left retained its natural relations to it. He observes, "after the lapse of several weeks, whilst the muscular irritability of the *left* posterior extremity was gradually *augmented*, that of the *right* was gradually diminished. We have, then, first the phenomena of loss of spontaneous motion on removing the influence of the brain, the excited or reflex actions remaining; and the loss of these on removing the influence of the spinal marrow; secondly, in the case of mere *cerebral* paralysis, we have *augmented* irritability, and in that of the spinal marrow we have the gradual diminution of this property."* Hence, his distinctions between cerebral and spinal paralysis. According to his reasoning, we have only to remove the influence of the cerebrum to augment the irritability of the muscles, because, he says, the brain "is the exhauster, through its acts of volition, of the muscular irritability."

---

* Opus cit., p. 213.

Two acute observers are not only opposed to his arguments, but deny the general accuracy of his facts. "Our own experience" they observe "is quite opposed to the statement of Dr. Hall, that, in cases of palsy, dependent or cerebral lesion, the muscles of the afflicted limbs acquire an increased irritability, from the cord, which he supposes to be the source of irritability, remaining intact, while the influence of the exhauster of irritability (the brain) is removed. In all our experiments, which have been numerous, we have found the palsied muscles less excitable by the galvanic stimulus than those of the sound side, and the difference has been more manifest the longer the period since the paralytic seizure. Exceptions to this statement, however, are found in those cases in which the paralysis has been accompanied with cerebral irritation sufficient to keep up a state of more or less *active* contraction of the affected muscles."*

---

* Opus cit., p. 214.

CCV. The views of Dr. Hall, which have been generally received, we shall endeavour to show are founded in error. The consideration of them will point out an important distinction which must be made in studying the phenomena of irritability. In the first place, let us clearly understand the meaning which it is supposed to convey. To the want of clear ideas on this subject is to be traced the extraordinary fallacies of this writer. Irritability is a property exercised by the muscles, and all other circumstances being equal, is, according to the neurologists, proportionate to the nervous energy they receive. This appears to be the opinion of Dr. Hall, for he says, "in paralysis arising from disease of the spinal marrow and its nerves, this irritability is diminished, and at length becomes extinct, from its *source* being cut off;" and further, that the spinal marrow "is the special source of the power in the nerves for exciting muscular contraction, *and of the irritability*

---

* Messrs. Todd and Bowman, vol. I., p. 341.

of the muscular fibre." The conclusion of the last sentence removes all doubt as to the office which he ascribes to the nervous influence.

If, therefore, the irritability of the muscles, is in the direct ratio of their nervous power, it necessarily follows, that the force with which they contract will conform to the same general law. Irritability is not a condition apart from muscular contraction. The latter implies the existence of the former and should be the measure of it. In fact, it is in virtue of such property, both in voluntary and involuntary muscles, that their movements are accomplished. But why should volition, exercised within legitimate bounds, be an exhauster of irritability? According to such reasoning, the action of the voluntary muscles is a debilitating process and opposed to their development and increase of strength. Daily experience, however, proves that it is essential to their growth and vigorous contraction. It is no objection to the argument to say, that the action determines to the muscles a greater amount of blood, and hence the subsequent changes. This fluid is of no use without the co-operation of the nervous principle. The augmented flow of the one is always accompaned by that of the other. Therefore, irritability in this sense, which is the only philisophical view that can be taken of it, is a measure of the power of muscular contractility. To speak of the muscles, in health, being *stronger* from the withdrawal of the influence of the will, would be an absurdity. They are strong, because they are richly supplied with nervous power.

CCVI. In numerous nervous and other diseases, and in weak and excitable subjects, the muscular system exhibits a variety of conditions which are designated by the *term* irritability. The agitation of the paralytic arm from emotion,—the unsteady muscular motions in chorea on the slightest surprise—the convulsive movements of the paralytic limb from the effects of strychnine, as well as from the agency of galvanism, are phenomena to which the term *irritability* is usually given. The previous definition will not apply to these cases. They do not present the manifestation of muscular strength, or, indeed, evidence of a vigorous state of the nervous system. In the paralytic limb, which is affected by emotion, strychnine or galvanism, the absence of the stimulus of exercise is indicated by the attenuation and comparative flaccidity of the muscles,—conditions regarded by Dr. Hall as proving an actual *increase* of irritability. Were such the fact, we should be under the necessity of admitting that the frequent contractions of the muscles in the various pursuits and pleasures of life, do not impart to them additional vital properties; or that the more debilitated any portion of the nervous system becomes from inactivity, either in consequence of cerebral paralysis or bodily exhaustion, the greater is the amount of nervous energy distributed to the muscular apparatus. This is indeed the conclusion at which he arrives.

CCVII. It is a law of the animal economy that the vitality of an organ, by which is understood its health and vigour, is in the ratio of its legitimate exercise. To narrow the sphere of its action, is to induce debility. His doctrine is not less unphilosophical than it would be to contend, that the energy of the circulation in the muscles is proportionate to their repose.

Irritability being justly considered as a measure of the nervous principle existing in the muscular system, *and, also, of the force of its contractility*, it is clear that when the latter property is obviously deficient, the manifestation of it, in the instances brought under notice, cannot be received as evidence of augmented irritability. The previous definition cannot apply to these cases. Such a condition of the muscular system or of any portion of it, may be truly designated by the term SUSCEPTIBILITY. There is a wide difference between them. As a general rule, the former is indicative of strength,—the latter of weakness or exhaustion. On this view all the phenomena to which Dr. Hall alludes, are explicable. The eye that has been withdrawn from light, cannot, at first, bear its influence; the animal economy debilitated by active depletory or other measures, especially in the highly sensitive, displays in a marked degree a tendency to excitability, both of the voluntary and involuntary organs; the paralyzed arm is readily affected by strong emotions, strychnine and galvanism; and all these are illustrations of weakness,—of a deficiency of the nervous fluid for the correct performance of the functions of life.

CCVIII. There is, also, another important circumstance to be named, in connexion with these two different conditions of the nervous system, to which different terms are here applied. The healthy and vigorous contractions of the muscles have an accompanying state of the brain and spinal marrow in harmony with them. There is not simply strength in the voluntary organs brought into play, but an aptitude on the part of these nervous centres to co-operate in the exertions. The nervous principle with which they are abundantly endowed flows in a copious current in the required directions, whether to exhibit feats of strength or agility. We will endeavour to explain our meaning by reference to an experiment which has an intimate bearing on these remarks. When a person takes hold of the *coiled wires* in connexion with the galvanic apparatus, he is able to resist, for some time, if possessed of great muscular force, the influence of the stimulus imparted, but at length his power of endurance fails and the instrument drops from his hands. During the efforts that he makes, the brain and the spinal marrow supply to the limb which is concentrating its energy, a liberal stream of the nervous fluid. Here is the harmony between these centres and the muscles. The amount which the latter receive, is, as already observed, a measure of their irritability or capacity of contraction.

When the same instrument is attempted to be grasped by one of less muscular development, we perceive the unsteady movements of the arm, the contortions of the features, the grotesque positions of the body, and the inutility of the exertions. Suppose one still weaker presume to try the feat, or imagine the partially paralyzed hand and arm from disease of the brain, were the subjects of the experiment, (which, according to Dr. Hall, would have their irritability or nervous energy increased,) the agitation of the limb would be instantly evident, and it would be as *powerless* as that of the child. So far from possessing an additional amount of the *vis nervosa* from the diminished agency of volition, the limited quantity which remains is at once overcome by the galvanic stimulus. The muscles and the nervous centres are, also, here in perfect relation, but how widely different are their conditions from those we have contemplated in the previous instance. We remark the strong lines of distinction between *irritability*, as indicative of strength, and *susceptibility*, as the manifestation of weakness. The explanation of the phenomena resulting from the galvanic influence, is equally just in reference to the action of strychnine and emotion.

CCIX. Before proceeding to show the application of these views, there is one other example we shall adduce, as a type of a large class of nervous affections, regarded as displaying great *irritability* of the nervous and muscular systems. In persons of a peculiarly excitable temperament, whose vital powers are greatly enfeebled, the slightest cause instantaneously produces strong palpitations of the heart, which often continue many hours. In such cases there is a marvellous tendency, on the part of the brain, to disordered action. The relations between it and the parts affected are morbidly delicate. The changes which have taken place in the character of these relations are fraught with no ordinary interest. The phenomena may be thus explained: Both the brain and its associated organs have a *diminished* amount of the nervous fluid. They are only just capable of performing with regularity their important functions. Hence their intense susceptibility of impressions. They have not that vigour or tone which is necessary to repel the disturbing influences to which they are subjected. An idea awakens a commotion in the cerebrum, and the consequent derangement of its finely-balanced nerves at once excites to convulsive movements the dependent and equally delicately-poised organs. These are conditions to which the term *susceptibility*, both in regard to the nervous and muscular systems, is alone applicable.

CCX. The previous considerations will now enable us to explain the effects of strychnine and galvanism on the paralyzed limb. The animating principle of the nervous system has a power of resistance, of external as well as internal causes, proportionate to the amount in which it exists. This is observed in the treatment of all diseases, if the operation of the remedies be accurately studied. The exceptions depend on circumstances which readily admit of explanation, and may be shown to present no substantial objections to the views here developed. No effect can be produced upon any part of the animal economy, without modifying the relations between this principle and its nerves, and consequently their associated organs. In giving rise to a *new* action, we disturb the conditions which co-existed in a previous vital process. If these are vigorous, their opposition will be correspondingly great: if weak, it is immediately subdued. If we descend from debility until we reach the paralytic limb recently affected, we have then an instance of an exceedingly low state of vitality, but not too depressed to exhibit re-action. The voluntary nerves are altogether unexercised. They convey no stimulus through the agency of the will to the muscles, and hence they cannot be regarded as co-operating actively in any vital operations. Accordingly, a limb so circumstanced ought to be particularly susceptible of the influence of strychnine, galvanism and emotion, *because the weakened state of the nerves can offer no effectual resistance to the stimulus which is brought into play.*

It must not be imagined from this reasoning, that the contractions of the paralytic are stronger than those of the sound limb when excited. The question is not the *strength* of the contractions, but the occasional *susceptibility* of the muscles to these different stimuli. And here the previous definition justly applies. It would be unphilosophical to suppose, (yet such is the conclusion which flows from the views of Dr. Hall,) that the well-nourished and freely exercised muscles of the arm, are incapable of being roused to an equal degree with the flaccid and motionless muscles of the paralytic limb. The force of the contractions, *cæteris paribus,* will always be proportionate to the vigorous condition of the organs.

CCXI. The strychnine which is given until it produces an obvious result, does not act on one part of the nervous system to the exclusion of the rest. It must affect the whole. The paralytic limb ordinarily first displays its influence. And why? The nerves belonging to the healthy portion of the body have not only their natural amount of the nervous fluid, which is an important circumstance, but are engaged in vital processes which have to be *overcome before a new series of vital phenomena can be excited.*

CCXII. It is remarked by Dr. Hall, that "the more perfect the paralysis, generally speaking, the more the irritability of the muscular fibre is increased. In hemiplegia, the arm is generally at once more paralytic and more irritable than the leg."* He further observes: "The arms and hands, generally speaking, are more under the influence of the cerebrum than the lower extremities; and these, on the other hand, are more under the influence of the spinal marrow than the arms and hands." This is in reference to the action of strychnine and emotion. These differences are easily explicable on the views here brought forward. The more complete the paralysis, which does not exclude the nervous conditions previously stated, the less is the *resisting* power of the nerves. The phenomenon harmonizes with the whole of our reasoning. Why the arms and hands should be more susceptible of emotion than the leg; and why the latter should be more affected by strychnine than the former, is, also, readily accounted for.

---

* Opus cit., p. 214.

Emotion exists only in the cerebrum: the strychnine pervades the whole of the nervous system. The arms and hands are much more frequently exercised than the lower extremities. They are called into action by every pursuit and occupation of life, and consequently have more intimate or extensive relations with the brain than the lower extremities. Hence it is that they exhibit a higher degree of susceptibility to emotion, which is the mind in its enlarged relations. It follows, also, from the same view, that in hemiplegia they should generally be more perfectly paralytic.

These principles explain, likewise, why *yawning* chiefly moves the arm, and *sneezing* more particularly the leg.* The former is an action extremely limited in its agency, and being a condition of the *cerebrum* only slightly affecting the spinal marrow, the manifestation of it is principally confined to the arms. Sneezing is accompanied with strong convulsive motions, and acts violently on the spinal cord, with which the *lower* extremities have comprehensive connexions. Hence their greater liability to be agitated by this reflex action of the nervous centres.

---

* Dr. M. Hall, Opus cit., p. 220.

There is a case mentioned by Dr. Abercrombie, which is an exquisite illustration of the truthfulness of this explanation and of the correctness of our reasoning on the phenomena occurring in paralysis. "I had," he says, "some time ago under my care a man afflicted with hemiplegia of the left side; the palsy complete, without the least attempt at motion, except under the following circumstances: he was much affected with *yawning*, and every time he yawned the paralytic arm was raised up, with a firm steady motion, until it was at right angles with his body (as he lay in bed on his back) the fore-arm a little bent inwards, so that the hand was above his forehead at its greatest elevation. The arm was raised steadily during the *inspiration*, and, when the *expiration* began, seemed to drop down by its own weight, with considerable force." This case confirms in a remarkable manner the nervous doctrines here laid down. The phenomena have not been attempted to be accounted for. Inspiration is the *active* operation of the brain. It calls into play the nervous principle, and though for a considerable period it had not flowed through the voluntary nerves of the paralytic arm, a condition of the cerebrum is induced which at once arouses these otherwise inefficient nerves. Expiration is the *passive* action of the organ,—the return of the respiratory muscles, in virtue of their elasticity, to a state of momentary rest. The patient gradually recovered, but for some time was liable to this affection.

The restoration of the natural motions of the limb, according to Dr. Hall, took place, "as the state of augmented irritability was *removed* by the returning acts of volition." When the poor and inactive arm had thrown off a portion of its superabundant nervous energy, which was unemployed, and had accumulated to an extent almost sufficient to paralyze the whole body, it regained at length the power of voluntary contraction. Why does not this physiologist suggest some mode of getting quit of this unnecessary *vis nervosa,* which is fraught with such lamentable results. Has his ingenuity no resources equal to the exigencies of the case? Can it be exhausted only by the will?

CCXIII. The reason here assigned why sneezing affects the inferior more powerfully than the superior paralytic extremities, will aid us in the explanation of the action of strychnine, which is said to influence the former in a greater degree than the latter. The lower extremities have more comprehensive relations than the upper to the spinal marrow. They draw their nervous power from a greater extent of it, consequently, as the agent operates equally upon every portion of it, the limbs the most dependent upon this nervous centre or deriving from it the greatest amount of the animating principle, *will sym-*

pathize most readily in every modification of its conditions.

CCXIV. It might possibly be advanced (as an objection to the views which elucidate the nature of nervous phenomena, such indeed as result from the action of emotion, strychnine and galvanism on the paralytic extremities, and establish the fact that their susceptibility arises in part from the limited amount of energy existing in the nerves,) that, according to this doctrine the contractions in the dead muscles ought to be regulated by the same law: the less the quantity present, the more excitable they should be. This could scarcely be seriously urged. The nervous principle, under such circumstances, is not co-operating in any vital actions: and after the cessation of these it is gradually dissipated, entering into new combinations of matter. The resistance which it offers in the healthy, compared with the paralytic limb, is not to be traced simply to the difference in its amount, but to the difference in the character or vigour of the vital processes to which it contributes. Were we to borrow an illustration from another science to render our meaning still clearer, it might be said that the nervous fluid has a much greater *attraction* to tissues possessing a high degree of vitality than to those in which it is deficient. Hence the greater difficulty to *overcome* that attraction in the one instance than in the other.

CCXV. It is stated by Dr. Hall, in confirmation of his peculiar views, "that sleep restores the irritability of the muscular system, by *arresting* the acts of volition."* That it is accompanied with the repose of the will, is unquestionably true; and equally so that the muscles are invigorated by rest. This is not only a restorative to the muscular apparatus, but to the whole of the nervous system. Nevertheless to suppose that it arises from the cessation of the acts of volition, regarding that as the only source of exhaustion, is to entertain very circumscribed notions of the important changes which take place in the vital powers. Sleep is one of the essential conditions of the reparative process both of mind and body, not merely from interrupting the operations of animal life, but, as previously observed, from allowing the whole of the nervous system to conform to new temporary circumstances. Every species of activity is necessarily at the expense of the nervous principle, and consequently to diminish the demand, is to facilitate an accumulation, by which it is enabled to enter again on the varied routine of offices inseparable from our waking hours.

The writer is compelled to confine the influence of sleep to the muscular system; as the *vis nervosa*, according to his views, has not the slightest connexion with the cerebral functions. These he regards as exclusively under the domain of the psychical principle, and hence his limited and distorted ideas on the widely pervading agency of the nervous system.

---

* Opus cit., p. 233.

CCXVI. Two recent and distinguished inquirers endeavour to prove, "that contractility is a property inherent in the very structure of muscle, and capable of being excited to action independently of the instrumentality of nerves."* The high authority of the expounders of this doctrine, and the new facts which they bring forward in illustration of it, render it necessary to refer to their labours. "It was," they remark, "long supposed impossible to observe the effect of stimuli on the muscular tissue when isolated from the nervous; but this question has been brought to an issue by the positive observation that fragments of the fibre of voluntary muscle, *entirely isolated* from every extraneous tissue, whether nerve or vessel, may be made to contract in obedience to a stimulus topically applied to them. When such fragments are examined, they are found to contract first of all where they have sustained mechanical injury, viz., at their broken extremities; and, if water be brought into contact with them, it is absorbed, and thereby excites them to contractions, which commence at their surface. The same thing is frequently to be observed under a different form. A particle of foreign matter, as a hair or a piece of dust, may be included by design or accident, in the field of the microscope, so as to touch the side of a fibre at a single point. When this happens, the fibre will often exhibit a contraction, so plainly limited to the point touched, as to give unequivocal proof of its being the result of the irritation of pressure."

---

* Messrs. Todd and Bowman, Opus cit., p. 175.

The value of their reasoning rests entirely on the supposed fact, that the fragments are destitute of nervous energy. Of this we have no proof. The absence of distinct nervous matter is no evidence of it. The nerves have imparted the animating principle to the muscular fibre, and it is in virtue of this that it contracts. The foreign matter rouses it into action. The experiment is a striking illustration of the views expressed throughout these pages. The irritability of the muscular tissue is clearly in the ratio of the nervous fluid which it receives. A galvanic battery is frequently constructed of the layers of flesh alone. If they possess the nervous power in the aggregate, under such conditions, why should not the fibres individually be endowed with it? It is impossible to define its boundaries; and it is scarcely philosophical to make the attempt. Through the agency of the nerves it is distributed to every particle of the living organism, and no vital phenomena can be exhibited independently of it. The scapel will not enable us to draw the line where it begins or ends.

CCXVII. The next phenomenon which is adduced in confirmation of their opinion, is the interesting fact, that on tapping with the fingers any muscular part of the body, when greatly emaciated by phthisis or other diseases, a defined firm swelling rises, at the point affected, and endures for several seconds. On this they observe, that being "limited to the point struck is full proof of its being a direct effect of the irritation, and *not produced through the medium of nerves;* for a contraction excited in the latter mode would be diffused over the parts to which the nervous twigs irritated were supplied, and would therefore frequently occur in parts at some distance."*

This is by no means a necessary sequence. The muscles, in the last stages of disease, often display a morbid degree of sensibility. The sharp tap will inevitably awaken the nervous principle in these organs, already painfully alive to impressions, and whatever momentary change is induced in them, is to be ascribed to its agency. They remark, that if it depended on the nerves, the effect would be discovered in parts, at some distance, supplied with the nervous twigs irritated. As a general law, the nervous energy flows *towards* such a local source of irritation, and not *from* it. This must not be confounded with the irritation of an individual nerve, where the influence is transmitted along its several branches. The two cases are very dissimilar. In the one instance, we operate on a mass of muscular fibres, drawing the nervous fluid not only from the cerebro-spinal system, the nerves of which are easy to be traced, but from a multitude of nervous filaments distributed to the arteries. The last source of nervous power is entirely overlooked by them. The sharp tap acts on a mass of muscular fibres, on arteries and veins, and on nerves different in their properties and origin; and yet according to their reasoning the effect should correspond with what occurs on irritating a single nerve. Such is the character of the imagined decisive evidence to establish the exercise of contractility independently of the nervous system.

---

* Opus cit., vol. I., p. 176.

CCXVIII. There is no phenomenon connected with the muscular apparatus of greater interest, or which bears more directly on our views, than the discovery of M. M. Becquerel and Breschet, showing the alteration which takes place in the temperature of a muscle during its contraction. If the exertion be continued for several minutes, it is said to be augmented two degrees Fahrenheit.

The writers to whom we have just referred,* and from whose valuable work we derive the fact, observe, that "this development of heat may be in a great measure attributable to, and even a necessary consequence of, the *friction* just alluded to." To say that it arises from the "movements of the neighbouring fibres upon one another," is not elucidating in any degree the subject. The parts thus acted upon must be endowed with some agent, the changes in the distribution and action of which can alone explain the result. What power is so likely to be instrumental in the production of it, as electricity? The disengagement of heat, in all cases of friction and pressure, will ultimately be traced to the modifications in the conditions of this principle. And the doctrine is as applicable to the living tissues as to inert matter. In each it has its particular laws and modes of operation, and in these respects only does it differ.

---

* Messrs. Todd and Bowman, Opus cit., p. 184.

CCXIX. These writers present an exceedingly important and interesting fact, in reference to muscular contraction, which, if true, is in direct support of the views which pervade this inquiry. They do not offer any explanation of it. They state that "a muscle contracts in *successive* portions, never in totality at once; and that no particle of it is capable of exhibiting an active contraction for more than an instant of time." "The sustained active contraction of a muscle is an act compounded of an infinite number of partial and momentary contractions, incessantly changing their place, and engaging new parts in succession; for every portion of the tissue must take its due share in the act."*

We have in a previous work,† as well as throughout these pages, endeavoured to establish a general law in regard to all muscular contractions, whether belonging to animal or organic life. We have shown, that the motions are necessarily intermittent, THE PAUSE BEING REQUIRED FOR THE SUPPLY OF THE NERVOUS FLUID ESSENTIAL TO EACH SUCCESSIVE ACT. It appears that the law is applicable to the individual fibres of which the muscles are composed. If such be the case, it is a striking and beautiful illustration of the theory we have propounded. According to this view, there is not only a general interval for the muscles in play, in order that they may recruit their energies, but also a period of contraction and repose, alternating with almost the rapidity of thought, common to the muscular fibres themselves, by which the supply of the nervous principle is secured, and the motions rendered more persistent than they otherwise would be. While one portion of the separate fibres is relaxed, having performed its momentary duty, another comes into play, and thus action and rest, in quick succession, occupying intervals of time which are scarcely appreciable, contribute to those general contractions which fall under ordinary observation.

---

* Opus cit., p. 182-3. † Philosophy of animated Nature, &c.

CCXX. The inference which clearly flows from this doctrine is, that each muscular fibre has an amount of the nervous principle equal to the demand which is made upon it; and that the current, expended in its successive contractions, is supplied in the corresponding intervals of repose. Regarding the phenomena in this light, and being thoroughly convinced that every action is a waste of vital power,—the loss of *something* which results from the co-operating functions of life,—it is difficult to imagine on what grounds the existence of one widely pervading agent can be denied: and when the intimate and indissoluble associations of the nervous with the muscular system,—the obvious influence of the former upon the latter, is considered, it is not easy to conceive by what train of reasoning these writers have been led to conclude, that the contractility of the muscles is *independent* of nervous power.

The action of the muscles is accompanied with the expenditure of a *something*, otherwise their exercise would not be succeeded by exhaustion; and, from the foregoing considerations, what conclusion is so natural, as that the agent is the animating power of the nervous system?

CCXXI. There is another important subject connected with the muscular apparatus, viz., the various degrees of irritability possessed by different animals, as particularly manifested in its duration after death. The inquiry is one of great interest and has given rise to several ingenious speculations to account for the phenomena. The law, however, by which they are to be explained, has not been fully apprehended. The scale by which the persistence of irritability is to be measured, may, with considerable propriety, be defined to be in the inverse ratio of the production of animal heat; or in other words, the more stimulating the qualities of the blood and the greater its changes in the respiratory organs, the more evanescent is the irritablity of the muscles. Accordingly it disappears the soonest in birds, less so in mammalia, and continues the latest in fish and crustacea. And it is further shown, "that not only does a less arterial character of the blood co-exist with a more enduring contractility, but, also, that there is less of it supplied to the muscles."*

---

* Messrs. Todd & Bowman, Opus cit., vol. I., p. 189.

It is scarcely necessary to remark, that the temperature of many birds ranges from 100° to 106° Fahr.; that of the higher orders of the mammalia from 98° to 104°; while in fish and the crustacea, it is only a few degrees above that of the medium in which they live.

CCXXII. We have endeavoured to establish throughout this inquiry, that the vitality of all organs is according to the nervous energy they receive, and that this is transmitted to them not only by the cerebro-spinal nerves, but by the ganglionic in association with the arteries; and that the more stimulating the arterial current, the more vigorous are the vital properties. From these views it would naturally seem to follow, that as the muscles, in the higher classes of animals, display these properties to a greater extent during life, they should retain them the longest after death: as two similar bodies, possessing different degrees of heat, occupy different periods in cooling. This illustration, however, will not apply on this occasion.

The allusion which was made to the production of animal heat, in connexion with the manifestation of irritability, was not for the purpose of showing that the modifications in the activity of the former will explain the diversities of the latter. Such activity is only one of several conditions with which it is combined. As a general rule, the more ample the respiratory organs, the greater is the development of the nervous centres, the brain or spinal marrow.

We speak of general relations, not wishing it to be understood that the one will be an exact measure of the other. The character of the respiratory functions is a just indication of the COMPLEXITY of organization, by which is implied, a greater variety of powers exercised by the animal, compared with the classes beneath it in the scale of creation, and, also, an intimate association between those powers, the performance of one necessarily depending on the existence of the rest. The consideration of the subject in this light will solve the difficulties which have hitherto embarrassed the inquirer.

CCXXIII. In man, for example, we have the large brain, the ample spinal cord and the extensive ganglionic system of nerves, all which constitute one indivisible nervous scheme, instrumental in different ways to the exercise of his tastes, desires and motions. His voluntary and involuntary muscles are equally dependent on these centres for the principle by which they are animated. *It is the degree of this dependence which is the key to the explanation of the diversities of muscular irritability.* The stream of rich arterial blood and the copious current of the nervous energy, transmitted to the muscles, are conditions in strict relation to the size and activity of the nervous centres; the cessation or destruction of which, is the gradual annihilation of the vital properties, whether muscular or otherwise, which are exercised in virtue of the uninterrupted co-operation of the complicated nervous system. The comparatively short duration of irritability, after death, is a just measure of the dependence of the muscles upon it. As we descend in the scale of creation, cerebral matter disappears with the limited range of intelligence, until at last we arrive at fishes, in which the cranial contents are chiefly ganglia, for the special office of the predominating senses; whilst in one large division of them, the cartilaginous, it is questionable whether cerebral lobes exist at all. When they are present, they are not organs from which radiates the nervous fluid to all parts of the body; nor do they influence or hold in subjection the same number of powers as distinguishes the brain in the mammalia. The muscles have other large nervous sources in harmony with them, from which they derive the animating current. Thus in proportion as the sphere of animal life is narrowed, the organic becomes the peculiar characteristic of the animal: or in other words, the nervous agent pervading the muscles not having the same comprehensive relations as in the superior classes, nor being consequently liable to the same variety of disturbing causes, the phenomena of irritability should not be the same, in the warm and cold blooded animals, after death, nor is it, and this has hitherto been the perplexing fact.

The diversities are not to be traced to a disparity in the amount of nervous energy distributed to the muscles, or to any conditions of the arterial stream conveyed to them, *but simply to a difference in the degree of dependence upon the nervous centres.*

The more circumscribed the dependence, and, as a rule, the more enduring are the properties of organic life.

CCXXIV. It has been attempted to be shown that the diversities in the duration of contractility, are explicable on the *slowness* with which the vital functions are carried on. It is observed, that "it is entirely consonant with facts to suppose that the endurance of the vital functions in the tissues, after systemic death, *is proportionate to the slowness with which they are ordinarily performed.*"* This is not the law according to which the phenomena take place. In many fishes the vital functions are evidently exceedingly active. If a tardiness in the processes of waste and assimilation be admitted to prevail, it will not elucidate the nature of the existing muscular conditions. It will throw no light on the variable relations between the nervous and muscular systems of the animals compared, which alone satisfactorily explain the diversified manifestations of irritability.

CCXXV. The writers endeavour to establish the justness of the doctrine which they lay down, by reference to the phenomena of hybernation, "in which," they say, "all the functions are held enchained, and we are certain that nutrition proceeds with extreme languor. In the hybernating animal, contractility is very enduring, as compared with that property in the very same organs when in a state of greater vital activity."†

---

* Messrs. Todd & Bowman, Opus cit., p. 188. † Ibid., p. 189.

It is scarcely possible to conceive a case that more aptly illustrates our own view. What is hybernation, but almost a complete cessation of the cerebral functions, which, in the waking state, through the agency of the senses and urgent organic necessities, establish the comprehensive relations between the muscular and nervous systems, and, as already explained, are unfavourable to the persistance of irritability. The almost perfect repose of these functions and the interruption to their exciting influence, are slowly assimilating, in one important respect, the animal to the conditions of the cold-blooded: they are conforming the vitality of its muscles to other centres of nervous action,—gradually narrowing its dependence upon the brain; and in proportion the irritability of the muscles is augmented. It is difficult to imagine how the almost arrested process of nutrition, should impart to these organs such property in a higher degree than exists under ordinary circumstances. According to *their* view, to increase the irritability, it is only necessary to circumscribe or weaken the vital operations, and greater the degree the more enduring is it. The study of it in the higher classes of animals, whose vital functions have been retarded or depressed, as shown in the emaciation of the body, as well as in those which hybernate, does not countenance this opinion. It is scarcely correct to compare the latter with the cold-blooded. The conditions of the two are so dissimilar. The one is in vigorous health, and adding to its weight from the nutriment received from *without;* the other only just gives evidence of life in the scarcely perceptible respiration, the feeble and slow contractions of the heart, the diminished sensibility, the shut up senses, the greatly diminished temperature: and, save the limited quantity of air inspired, the vital functions are carried on at the expense of the body. The processes of waste and assimilation are presented, in such cases, in a refined degree, and if such be essential to the confirmation of their hypothesis, the persistance of irritability should be displayed to a marvellous extent.

CCXXVI. There is a tone or quality of muscles which is peculiar to each individual. The largest development is not necessarily distinguished by the greatest strength. Size, *cœteris paribus,* is a measure of power. It is not, however, possible, from their external conformation, to arrive at a just estimate of the relative amount of fleshy fibres of which they are composed. Their bulk is often largely made up of cellular tissue and fat. Hence lean persons have frequently a degree of strength out of all proportion to the apparent magnitude of their muscles. Independently of these circumstances, there is, nevertheless, a tone which gives them a distinctive character; and, as far as our opportunities of observation have extended, we should say, that it is to be traced to the *predominating* quality of the nervous system, the development of which, in the cases compared, being supposed in all other respects equal. An innate active condition of the nervous system, is one of the elements necessary to great efforts of strength and to enduring exertions. The temper of the mental faculties will enable us to form a general estimate of the *quality* of the muscular fibre. Where they operate slowly or with difficulty, or in other words, where they are not marked by scintillations of fire or energy, it is vain to calculate on any decided muscular tone. The more ample the relations between the nervous and muscular apparatus, and the more these relations are enlarged by exercise, the greater is the force of muscular contractility.

The term *wiry,* (which is frequently applied as indicating a peculiar vital condition,) is an element which the practitioner regards as important in regulating his opinion as to the issue of disease, and *depends on the energy of the nervous current habitually imparted to all organs.* It frequently co-exists with great leanness or delicacy of bodily structure. It is indeed an illustration of the predominance of the nervous over other tissues. In persons of this temperament, active depletory measures are invariably fraught with baneful results. The animal system has no fluids to spare. The treatment should have an especial reference to the prevailing character of the powers of life. The abstraction of blood has been carried, in all affections, to an unnecessary and melancholy extent. The practice, even its present mitigated degree, will form one of the dark pages in the history of medical science. The reasons alleged for its adoption, and the beneficial consequences presented as flowing from it, are equally evidence of a miserably limited knowledge of the vital functions.

CCXXVII. The effect of lightning on the animal economy is familiar to every one. When it is fatal, the muscular irritability and the coagulating property of the blood, are destroyed. As according to our views, the animating principle enters into and promotes all vital combinations, it follows that whatever disturbs or annihilates them, dissipates the agent by which a variety of elements are associated in the production of the phenomena of life. The influence is equally detrimental to vegetables, and from the same cause. The same mysterious power operates in both. The difference in its manifestations is in harmony with the laws of organization. Similar results are observed in cattle driven beyond their strength; and the same explanation applies in this case. The long continued exertions are a protracted drain upon the nervous principle, whether existing in the nervous centres or the circulatory fluids, and though it responds for a lengthened period to the demands made upon it, it becomes, at length, unequal to the maintenance of the vital processes, and hence the flaccidity of the muscles and the uncoagulating condition of the blood.

CCXXVIII. In the foregoing analysis we have endeavoured to bring under consideration, a large and important class of nervous phenomena, the origin and nature of which have been variously, but in our opinion, erroneously explained. As frequently remarked throughout this inquiry, physiological principles, if justly founded, have always a direct application to the elucidation of the diversified states of the animal economy, in health and disease. If they do not manifest this property, they are either false or not understood. The doctrines of Dr. Hall do not, even in his own hands, display it, except on an exceedingly limited scale. On the contrary, the views by which our investigations are guided, have an immediate reference to every condition of the powers of life; whether riotous from the exuberance of energies, or languid from their depression; whether pursuing the even tenor of its duties, or disturbed by the inroads of disease. But here ends not their application. They have a comprehensive bearing on the philosophy of the mind in all the variety of its operations, whether regarded as effects arising from bodily and other circumstances, or as causes which leave a permanent or evanescent impression upon the living tissues.

CCXXIX. Our own recent researches place beyond all doubt the dependence of muscular contractions, and consequently their irritability, on the nervous principle. The light which they throw on this interesting department of science, is not less satisfactory, than it is beautiful from the mode in which it introduces new truths to our observation. We allude to the mesmeric agency. We have repeatedly and instantaneously accelerated and lessened the actions of the heart; we have given to the voluntary muscles a power which they did not naturally possess; we have guided their movements independently of the volition of the individual, and in defiance of the determined efforts to resist our influence. We have produced these effects not only when the mental faculties were in conscious exercise, but in the profound stupor of sleep. We have, also, excited the brain to the manifestation of its powers, with a precision and accuracy that is truly marvellous.

It is amusing to trace on this long and bitterly agitated subject, the gradual transition of opinion,—the growing admission that mesmerism is a great truth. The sentiments expressed in the successive editions of the works of its numerous opponents, would form, if collected, an interesting episode in the history of medical science; and would not be without value to the future daring innovators of prevailing doctrines. Interested motives,—zeal without discretion,—incapacity of reasoning,—love of novelty and a passion for notoriety, were a few of the charges which were sweepingly made, and in language as uncourteous as it was unjust, against the enlightened inquirers into mesmeric phenomena; among whom stands preeminent Dr. Elliotson, whose ardour in the cause of truth is equalled only by his acquirements and talents.

Humanity owes to such a man a debt of gratitude, which cotemporary liberality has never the honesty to acknowledge, much more to pay.

Our own multiplied experiments establish one important truth, which cannot be too strongly impressed upon the mind, *viz.*, THE EXISTENCE OF ONE AGENT THROUGHOUT THE ANIMAL SYSTEM, WHICH IS THE SOURCE OF ALL VITAL OPERATIONS : THE MODIFICATIONS IN THE DISTRIBUTION OF WHICH ARE THE FIRST PROCESSES IN EVERY DISORDERED VITAL ACTION. We do not condescend on this occasion to particularize the facts which confirm these conclusions ; nor, indeed, to argue the grounds on which they rest. We have neither time nor inclination for either. Let others investigate for themselves. Incredulous and sceptical, let them trust only their senses acutely alive to the refined spirit of philosophical inquiry.*

CCXXX. The muscles are the seat of numerous affections, such as the loss of sensation, a morbid degree of sensibility, twitchings, irregular actions, spasms and inflammation, all which are to be traced to the altered conditions of the nerves. They alone are the recipients of all impressions,—the agents which modify all vital functions. Whatever be the nature of the changes induced, the first effect is inevitably upon the animating principle of the nervous system, and the results ARE SIMPLY THE MEASURE OF ITS DERANGEMENT. This applies as strictly to inflammatory as to nervous diseases. The latter term might with logical precision be given to the former class of maladies. A difference in their symptoms does not establish a difference in their origin, and, in their nature, only so far as the disorder of the nervous energy, in the one case, indicated by the feverish excitement, is generally far greater than in the other.

---

* See the Philosophy of animated Nature, &c.

If any of the classifications of diseases assumed, as a basis, the importance of the several systems in the production of vital phenomena, or as the most implicated in every deviation from health, almost all diseases might with propriety be designated nervous. Nay, further, enlightened and comprehensive principles of treatment can be founded only on such a view. For in what does the just application of remedies consist? Here the word *just* has a large significance. It is not confined to the investigation of the nature of the affection, or the properties of particular remedies. These are essential elements to guide the judgment. There is, however, one other consideration, *viz., in what mode or through what channels, can the disease be most efficiently controlled?* The answer to this question has hitherto been an impossibility. The ever varying rules of practice and the arguments by which it is enforced, are evidence of the truth of this remark.

With the prevailing limited knowledge on the nervous system, how could the practitioner see the shortest road to the seat of the evil, even if familiar, which is not the general rule, with the doctrines of the physiologist? By one school he is told, that voluntary and involuntary motions are independent of any power derived directly from the nerves; that in fact they are the result of a *vis insita* in the muscular fibre: by another, he is taught that all these motions *probably* depend on a *vis nervosa,* whilst the brain and its wonderful faculties have not the slightest connexion with it, or with any nervous influence: the cerebrum being the exclusive domain of the psychical principle. This immense organ, with which all parts of the nervous system are associated, from which it receives impressions and to which it distributes the motive power, is, according to such reasoning, pervaded by no agent which is common to the whole. He is further informed that the functions of the nerves consist in conveying a series of vibratory movements, and that all vital phenomena are explicable on this view; or that the nerves do really transmit a *something,* but agreeably to what laws, is not stated. He is, however, more frequently amused with the ingenuity and eloquence, which demonstrate the perfect fallacy of all such opinions. The idea that the nervous system is animated by any power, is ridiculed with pointed facetiousness.

Is it possible amidst this chaos of physiological doctrines,—this clashing of conclusions on the nature of vital action, for the mind, how anxious soever it may be, to discover the direct road to the seat of disease? Which is the path according to the received notions? One, groping in the search, acts energetically on the bowels, or thoroughly relieves the stomach of its contents; another detects the evil in the blood, and emits a copious stream; a third, ascertaining the dry state of the skin, determines the fluids in that direction. In none of these modes of treatment, or in others, which it is unnecessary to notice, is there a clear and comprehensive view of the powers of life, or indeed a knowledge of the laws according to which they operate. This would point out the degree of efficiency which is exercised by each in the production of the morbid results, on an accurate conception of which all medical treatment must be founded. It would indicate to the practitioner the shortest course to the desired object.

CCXXXI. It is the derangement of the nervous system in all inflammatory diseases, which gives rise to the variety of their symptoms. The increased force of the heart, the full, strong and stimulating current of the arteries, the hot skin, the frequently distressing thirst, the flushed countenance, the disturbance of all organic functions, and consequently whatever appertains to animal life. If these phenomena are justly to be traced to the disordered action of the nervous system, *the efficacy of the means employed will unquestionably depend on the degree in which this is influenced;* and the study would be to ascertain in what way the necessary change could be produced most readily and with the greatest safety. Hence the consideration of the nervous functions is as important in this class of diseases, as in any regarded as purely nervous. There is no difference in the character of the knowledge required for the judicious treatment of any of these morbid conditions. The same light elucidates the nature, progress and termination of all deviations from health. We hesitate not to assert, presumptuous as the remark may appear, that the carrying out of these views will ultimately modify the entire aspect of medical science. They will lay a foundation for principles, simple and efficient, and far more comprehensive than any that have yet been given to the world.

SECTION VIII.—THE RELATIONS OF THE NERVOUS SYSTEM TO THE SKIN.

CCXXXII. The cutaneous surface in its relations to the powers of life, is replete with interest, and the study of it has a practical value which has not been appreciated. It has extensive nervous connexions with every part of the animal system. It is affected in a marked degree by emotions. At one time, it is pallid from fear; at another, it is coloured by shame or indignation. On the face it ordinarily displays the lively impressions of the mind: and this arises, from the peculiar delicacy of the investing membrane (a relatively greater amount of blood and nervous energy being distributed to it);

and, also, from its association with the frequently excited conditions of the brain. Hence the facility with which it manifests the often otherwise unexpressed mental feelings.

Elaborate experiments have been undertaken to determine the quantity of the cutaneous exhalation in a given period, and the results arrived at have sufficient accuracy for all practical purposes. Valuable as they are, as evidence of vital operations, they have not led to an equally minute inquiry into the causes by which they are affected, in health and disease.

CCXXXIII. The skin is usually described as consisting of three membranes, the epidermis, which is external, the corium, which is internal, and the rete mucosum or *reticulum*, which is intermediate. The last is said to be demonstrated in the negro race only; it is, however, asserted to be always present, by Malpighi, Ruysch, Meckel and Béclard; and has been discovered by Dutrochet in the skin of the lower animals. On the other hand, its universal existence is denied by Bichât, Chaussier, Gordon, Rudolphi and others.

On no subject is there, perhaps, a greater discrepancy than exists concerning the cutaneous tissues. And if any thing were calculated to throw doubts on microscopical examinations, it would be the extraordinary differences of opinion on this branch of inquiry. Objects acknowledged by one to elude all observation, are not only discerned by another, but are described with as much minuteness as if they were too large to escape the most ordinary investigation; and yet, unfortunately, the secret of tracing them is confined to the original discoverer.

The most remarkable of this fruitful class is M. Breschet. He defines eleven organic elements entering into the composition of the skin, among which we have *inhalant* vessels; a *chromatogenous* organ for the secretion of the colouring scales of the epidermis; the *gland* and *duct* of the *blennogenous* apparatus for the secretion of the mucus which co-operates in the formation of the cuticle; and each of these is beautifully delineated by an appropriate diagram; and yet he is afterwards under the necessity of greatly modifying his views on the very objects which he describes with extraordinary precision: and others have shown, that several of his distinctions arise from a misapprehension of the structure and relations of parts which really exist.

CCXXXIV. This subject has recently been examined by two physiologists whose researches are worthy of especial attention.* They bear the impress of great labour and accuracy, and are distinguished by a degree of logical acumen and sobriety of judgment, which do not always accompany microscopical investigations. The imagination is frequently too active in such pursuits. Their description of the tactile papillæ, the sebaceous and sweat glands, the hair follicles, the structure and relations of the hair, is clear and satisfactory. The chief novelty of their views, is in showing that the rete Malpighi is in no case a distinct membrane, the colouring matter consisting of oblong or oval grains of extreme minuteness, "occupying the interior of some of the epidermic particles." Such diversities of opinion might well make Broussais exclaim, "the more we read and meditate the works of those authors who have investigated the structure of the skin, the less certainty do we acquire on the subject of its intimate structure."*

---

* Messrs. Todd and Bowman, vol. I., p. 406.

CCXXXV. The epidermis appears to be for the purpose of protecting and moderating the important functions which are exercised by the cutis vera. It possesses neither nerves, blood-vessels nor absorbents. It is generally regarded as extra-vascular and inorganic. Though it is penetrated by the hairs and allows the passage of fluids, the most minute examination has not detected in it the slightest trace of any apertures. Hence it is quite unknown through what channels the secretions escape.†

A just idea of the protection which it affords to the more vital organs beneath, may be formed from the fact, that wherever it is destroyed, or its structural conditions are materially altered, a variety of substances will immediately pass into the system, which during the integrity of the cuticle might be applied to its surface with impunity. It must not, however, be imagined, that it is an effectual barrier to all absorption, an inference which has been drawn by several distinguished experimentalists. The more recent researches of Stevens and Mitchell, prove the facility with which gases intermix and permeate animal membranes. It is considered to be a secretion of the true skin, and is constantly renewed throughout the course of life. Though devoid of all vessels and nerves, it is not correct to regard it as totally inorganic. It forms an essential part of the living structures, and exercises functions which necessarily imply the existence of some degree of vitality. Whatever, indeed, belongs to the animal economy, whether the hair, the nails or the epidermis, possesses this to an extent in perfect harmony with the nature of its action.

---

* Treatise on Physiology applied to Pathology, translated from the French by Drs. Roche and Bell. Philadelphia. P. 68.

† Eléméns d'anatomie Générale Par Béclard, § 313.

CCXXXVI. Concerning the next membrane, the rete mucosum, as already remarked, there is great difference of opinion. In the coloured races it is easy of demonstration. Like the epidermis it is devoid of nerves and blood-vessels. According to the views of M. Flourens, its designation should be replaced by that of pigmental apparatus, *appareil pigmental,* which is a plate or layer on which the pigmentum rests, and above which he considers there are two cuticles. This special *appareil,* he says, is wanting in the white variety of the human family.

CCXXXVII. The corium is the last of the three membranes to which we shall briefly allude. It is formed of dense fibres which intersect each other in various directions, leaving spaces or intervals for the passage of the nerves and vessels. It is generally attached to the parts beneath by loose cellular tissue. Its outer surface is smooth and richly studded with papillæ, which are most abundantly supplied with nerves and arteries. Béclard, in reference to it, says, " où il y en a des myriades, qui, par leûrs dernières divisions, constituent les papilles et le réseau vasculaire." When the latter is successfully injected it presents one uniform and beautiful network of vessels.

The cuticular surface of the corium is much more vascular than the one which is united to the cellular tissue. It is admitted by the most accurate observers, that the duct of the sebaceous glands opens into the follicle which contains the hair. This fact is of some interest in regard to the views proposed to explain the functions of the latter in the animal economy. It is singular, considering the organic connexions of the hair, placed as it is in the centre of nerves and blood-vessels, that no speculations were ever hazarded to account for its probable office, except that it was either to keep certain parts of the body warm; to protect them from the frequent intrusion of foreign matters; or was given as an ornament to enhance the beauty of the human figure.

The nature of the actions which take place on the skin, such as touch, secretion and absorption, would lead us to calculate on structural conditions in accordance with the functions performed. The large quantity of blood and nervous energy existing in this situation, is, alone, not only evidence of the extensive processes carried on, but, also, a necessary sequence, of the intimate relations which the surface maintains with every part of the animal system. The greater the quantity, the more influential are the established relations. The two associated fluids form one uninterrupted and indivisible vital chain, and whether belonging to the exterior of the body or the internal organs, their disturbance in any region will inevitably affect, though not always in a perceptible degree, the *whole* of the powers of life. Almost every disease is an illustration of the truth of these remarks, which are, indeed, fraught with valuable practical suggestions.

CCXXXVIII. We shall proceed to examine the functions of the skin in their two comprehensive relations, first, to the external world, and secondly to the animal system: One of the most obvious and important, is that of exhalation. It has varying degrees of activity. At one time, when the body is in health and unexcited, the vapour which is constantly thrown off, is designated *insensible* perspiration; at another, either from exercise, stimulants or any other cause, the secretion is augmented beyond the power of the surrounding air to remove it, and hence its condensation on the surface, termed *sensible* perspiration. The latter is said to contain "an excess of lactic acid, a small quantity of the same alkaline and earthy salt, and the same incoagulable animal matter as the serum, and, also, of an oil, probably in part, but not wholly, formed in the sebaceous glands."* "Berzelius regards it as water, holding in solution the chlorides of potassium and sodium, lactic acid, lactate of soda and a little animal matter; and Anselmo, as consisting of a solution of osmazone, chlorides of sodium and calcium, ascetic acid, and an alkaline acetate, salivary matter, sulphates of soda and potassa, and calcareous salts, with mucus, albumen, sebaceous humour and gelatin in variable proportions."†

When it is considered that the waste from the lungs and the skin together, attributable to exhalation, in the twenty-four hours, is about forty-five ounces, and that fifteen is derived from the cutaneous surface, a general idea may be formed of the extent and character of the vital actions of which it is the seat; as well as of their vast relations to the rest of the animal economy.

CCXXXIX. Dr. Edwards, one of the most accurate and distinguished of modern physiologists, argues that the insensible perspiration is a purely physical process, taking place in the dead as well as the living body. According to his views the sensible perspiration is alone a vital transudation or secretion. The chemical composition of the two presents some differences. The former is said to contain a greater amount of carbonic acid, and the latter a larger proportion of salts. The circumstances under which they are produced would certainly lead us to anticipate a difference in this respect. The one occurs in the unexcited operations of the cutaneous surface: the other when these are stimulated in health either by internal or external causes. In the one case, the effects are in harmony with the ordinary necessities of the animal system, and are a just measure of their vital character: in the other, the nerves and glands of the skin are aroused to vigorous action, with all their energies brought into play, and hence, as a necessary consequence, the results will clearly be in relation to the conditions from which they arise.

---

* Alison, Opus cit., p. 96.

† Human Physiology, by Robley Dunglison, M.D. Sixth edition, vol. II., p. 262.

There are remarkable illustrations of the correctness of this view. Sudden emotions immediately modify the qualities of the urine. It not only becomes pale, but is found to be less copiously endowed with its usual constituents. Here a diminution of the nervous power is accompanied with a corresponding alteration in the secretion. A vital action may be complete, imperfect or greatly augmented, and were our means of analysis sufficiently refined, it would be shown that in all these instances the chemical elements were variously modified. It is an inevitable effect. An able writer remarks, "our knowledge on this matter is vague;"* but this arises less from the limited resources, at command, to acquire accurate information, than the want of steady and well directed investigation to this important branch of inquiry.

---

* Dr. Dunglison, Opus cit., p 270.

CCXL. The distinction which is endeavoured to be established between the nature of sensible and insensible perspiration, does not do credit to the usually philosophical character of its expounder. There are no facts by which it can be proved, and it is at variance with our knowledge of the laws of the animal economy. A difference in the degree of any organic process, is no just reason for referring one order of phenomena to the exercise of vital properties, and another to a cause which is common to inert matter. Nature works not in this way. Her laws are uniform in their operations. What is insensible exhalation, but an effect in strict accordance with the prevailing vital conditions, which varies with every change in them? Is it possible to imagine that the glands and cutaneous capillaries pour out their secretions, at random, irrespective of the necessities of the animal system? If not, where are the grounds for the distinction between their normal and excited actions? It is illogical to suppose any to exist.

CCXLI. There is no part of Dr. Edwards's admirable treatise more open to objections, than his views on this subject. He remarks, "there are three conditions which have a notable influence upon perspiration, viz., the hygrometric state, the motion, and the pressure of the atmosphere. *They act only upon the insensible perspiration;* it is that which is increased by the dryness, the agitation, and the rarefaction of the atmosphere. These causes do not *produce* sweat, at least directly, and the reason is evident,—because they act in a *physical* manner, they diminish the mass of liquids by causing a part to be converted into vapour. Sweat, on the contrary, is a loss ordinarily produced by a *vital* action, in the form of a liquid which transudes."* He further observes, "all that is lost by *insensible* perspiration ought not to be considered as the result of perspiration by evaporation. Is not the skin an excretory organ capable of eliminating from the body a certain quantity of liquid, independently of the co-operation of external agents, in like manner as the urinary organs separate, and reject a part of the materials of the blood?"

The atmospheric conditions to which he alludes, increase the insensible perspiration. And why? Because they facilitate the escape of the vapour as it is formed, an effect which is immediately felt by the secretory glands and vessels of the skin. The readiness with which it is removed, gives rise to a correspondingly augmented action of these organs. They furnish the supply according to the demand or waste until their energies are exhausted. The insensible perspiration is, under ordinary circumstances, in harmony with the existing state of the vital powers. To increase it unduly by external means, is to disturb the balance between it and these powers; but this cannot possibly convert a vital process into one that is purely physical, whatever be the nature or extent of the derangement. His argument applies as strictly to sensible as to insensible perspiration. It rests on the fact, that certain conditions of the atmosphere accelerate the production and removal of the latter. Do not certain conditions, also, influence the production and dissipation of the former?

---

* On the influence of Physical Agents on Life, by W. F. Edwards, M.D., F.R.S. Translated by Dr. Hodgkin and Dr. Fisher. P. 171.

He observes, that if transpiration "did not exist, perspiration by evaporation would notwithstanding go forward; on the other hand, transudation takes place independently of the other mode of perspiration. Perspiration by evaporation takes place in the *dead* as well as the living body."* To compare the exhalation from dead matter with that which happens during life, is unphilosophical. The removal of it, in the one case, is not accompanied by any organic operation that affects its production. The evaporation goes on until not a particle of moisture remains. In the other, the influence of external agents is constantly modified by existing vital actions. Transudation may occur independently of perspiration by evaporation. And why? Not because the two arise from different sources, but because there are different degrees of activity of the same general apparatus, each in perfect accordance with the prevailing vital energies. To endeavour to establish a distinction on such grounds, is scarcely less illogical than it would be to contend that the raising of the finger is not due to volition, because this power is frequently manifested in imparting motion to the whole body.

---

* Opus cit., p. 172.

He remarks, "all that is lost by insensible perspiration ought not to be considered as the result of perspiration by evaporation." How is the distinction to be drawn? Who, according to his own principles, can define the line between that which escapes as a natural secretion, and that which is produced by or largely dependent on atmospheric conditions?

In the attempt to display the importance of transudation as a vital process, he does not exhibit an accurate knowledge of the character of the cutaneous functions. He says, "it is a remarkable, but well known fact, that when life is sinking, and to appearance nearly extinct, the body is covered with sweat—so strong is the tendency to continue this function." (Transudation).*

This is no evidence of any such tendency. Had he argued that the effect, in this particular instance, is due rather to *physical* than to vital causes, he would have been much nearer the truth. On these occasions it can scarcely be regarded as a secretion, if by the term is implied the exercise of those vital properties by which a variety of elements are evolved from the blood. The fluid *escapes* because the capillaries have not the power to retain it. When it occurs, as a normal secretion, it is not the result of the debility of these organs, but of their stimulated action through the agency of the nervous principle.

---

* Opus cit., p. 30.

A similar phenomenon, as already observed, is exhibited by the kidneys when their functions are depressed by powerful emotions. The urine flows in abundance, but it is found to be deficient in its usual constituents. When the tone and vigour of the animal system are broken down, and the blood is obviously diseased, the cutaneous capillaries allow it to ooze out. This is no more the exercise of a vital action on their part than the process of transudation in the last moments of life.

These views have not only been adopted by several distinguished writers, but have been considered as exceedingly valuable in elucidating a large class of interesting phenomena. With what propriety it is for the intelligent reader to decide.

CCXLII. It is yet a contested point whether carbonic acid is produced on the surface of the skin. Such is found to be the case in numerous experiments on cold-blooded animals. It would appear that where the oxygenating apparatus is exceedingly limited, the cutaneous surface compensates for the circumscribed action, by taking upon itself the office of more perfectly eliminating organs. In warm-blooded animals the fact is not equally well established. In support of it we have the authority of Cruikshank and Abernethy, Jurine, M'Kenzie, Collard de Martigni and others; most of whom, especially Jurine, instituted a series of elaborate and well-devised researches on the subject. Among the opponents of the doctrine, we have Priestley, Klapp and Gordon. The weight of evidence is unquestionably in favour of the production of carbonic acid. Its disengagement probably depends on the state of the vital powers.

CCXLIII. It is, also, satisfactorily proved by several of the foregoing authorities, as well as by others, that the skin is capable of absorbing different gases in contact with it. The experiments of Sorg clearly establish the absorption of oxygen; and it has occasionally been found to be replaced by carbonic acid.

CCXLIV. The most interesting considerations connected with the functions of the skin, are its nervous properties, which have not been studied with the attention they deserve. The vast amount of nervous matter in the cutis vera, is in harmony with the extensive actions of which it is the seat. The one is a just indication of the other. It maintains important relations with every part of the animal economy. Every organ must inevitably sympathize with its varying conditions, and through one channel only,—the nervous medium.

CCXLV. The whole surface of the body is an extensive organ of touch. Its sensibility in different situations, is according to the nervous papillæ which exist. It is the greatest in those parts which minister to our pleasure, or which are designed to inform us of the qualities of external bodies, as the lips, the fingers, the toes, the palms and soles. It is scarcely necessary to remark, that their susceptibility to external impressions, may be heightened to a marvellous degree by a refined practice. Persons can distinguish colours by the touch, write with the toes, and appreciate with considerable accuracy the weight of substances from simple contact or slight pressure. The same sensitive surface makes us familiar with the alterations of temperature. The intimations which it gives are, however, of a relative rather than of an absolute kind; and the sensations excited will vary not only with the changes in the external circumstances, but with the extent of the surface influenced, which is supposed to arise from more forcibly attracting the attention.* The effect is to be ascribed to the greater intensity of the impressions conveyed to the mind. The acuteness of the sensations is a measure of the nervous papillæ directly operated upon. The aroused attention is the result, and is in strict relation to its immediate cause.

CCXLVI. An interesting class of phenomena originating in the exterior of the body, are the convulsive movements occasioned by titillation. The parts which are the most sensitive, are the soles, the armpits and the flanks. In highly nervous individuals, it is almost a matter of indifference what region is touched; and, at times, even the attempt is sufficient to give rise to the ordinary consequences. The susceptibility evidently depends chiefly on the conditions of the brain, whether natural or induced. Sometimes it is impossible to excite the usual effects, and the power altogether ceases in cases of profound grief and disease. It is observed by Broussais,* that in gastritis the patient is incapable of being affected, but that the sensibility gradually returns after the application of a few leeches. The same, also, occurs in other inflammatory affections. He explains the phenomenon on the supposition, that the brain is too much occupied with existing sensations to attend to others arising from a different source. This is in part correct, but it is not the whole truth. There is not only an important change in the cerebral functions, but equally so in those of the nerves. All writers overlook the modifications in the latter, as if they were inorganic threads and unalterable in all the vicissitudes of vital action. Their office is to convey the animating principle to all organs according to their necessities, and, on the interruption or diminution of these, it flows in other directions. In gastritis, or any other severe affection, it does not pervade the peripheral extremities of the nerves in its usual quantity, consequently they lose a portion of their susceptibility. That such are the effects produced by acute diseases, is not a mere conjecture. It rests on incontrovertible evidence furnished by mesmerism. Persons who are exceedingly sensitive in health to its influence, exhibiting a high degree of muscular rigidity, have in our experiments generally ceased to manifest this particular condition when attacked with inflammation. This seems a natural result. Health implies a balance of the vital powers, and especially of the circulatory and nervous, the co-operation of which is the source of all the phenomena of life. Disease is the disturbance of this balance, and not less truly is the motion of the blood modified in its countless series of vessels, than the distribution of the animating principle in its equally extensive system of nerves. The changes in the latter, arising from and accompanying all diseases, have never awakened the attention of the physiologist; and his labours certainly exhibit no accurate or comprehensive knowledge of those occurring in the former.

---

* Messrs. Todd and Bowman, Opus cit., p. 432.

---

* Opus cit., p. 71.

CCXLVII. In the works of medical writers many instructive cases abound which establish the general truthfulness of these views, and illustrate the remarkable changes in the sensibility of the cutaneous surface, from the disturbed circulation of the nervous fluid: and it may, perhaps, appear singular that they are mostly traceable to an unnatural indulgence of the sensual propensities. Dr. Marshall Hall relates the following:—"The skin was so susceptible to impressions in certain parts of the surface, that the patient was affected with a sort of general emprosthotonic spasm, with a slight sob whenever the bed clothes, for instance, were drawn over the chest, and still more especially when the penis was accidentally touched in a similar manner."* A case, however, is related by Burdach, which strikingly corroborates the whole of our reasoning. "Le matin, quand ce jeune homme avait pris son repas et apercu des femmes qui lui plaisaient, ses mains devenaient le siége d'une chaleur agréable, que le frottement exaltait jusqu'à la rendre brûlante, après quoi survenait une syncope voluptueuse, à laquelle les organes génitaux ne prenaient aucune part; si parfois il survenait des érections et une emission de sperme par les selles, ces phenomènes cessaient d'avoir lieu au mains."†

It is scarcely possible to conceive symptoms displaying more forcibly the modifications in the distribution of the nervous energy and the striking manifestations of derangement, than these present. Like the blood it is susceptible of accumulation and dispersion. The animal economy, at any one moment, has only a given quantity, and if not employed in the performance of one species of vital action, it will indicate its presence in the production of another, and often of an extraordinary kind.

The nervous system, in the latter case, was in an extremely morbid state. Its energies had been repeatedly excited and exhausted, until the whole of the nervous organs had lost their natural tone and character. The brain was acutely alive to the slightest impressions, and the aggravated effects which immediately flowed from it, were evident in the exalted heat of the hands and the voluptuous insensibility. When the generative functions were aroused, the temperature of the hands became normal: and when the latter were the seat of great heat, the former were unexcited, as if the nervous fluid were unequal to the maintenance of both conditions. It is clear that the existence of the one was invariably marked by the absence of the other.

---

* Opus cit., p. 240.

† Traité de Physiologie, tome VIII., p. 245.

These, and numerous similar phenomena, are inexplicable on any of the received doctrines. Indeed no physiologist has attempted to account for them: They are regarded as amongst the mysteries of nature. The solution of them according to our views, is the legitimate application of the principles which pervade these inquiries. Whatever may be thought of the value of the theory, it will be found not less fruitful in the suggestion of remedies to correct morbid deviations, than it is in the elucidation of their origin and progress. When theory and practice are thus found to be in harmony, there are strong grounds to accept the interpretation of the former.

The extraordinary sensibility which these cases exhibit, was clearly traceable to the unnatural indulgence of the sensual propensities. Phenomena scarcely less striking, arising from the same cause, have fallen under our observation. As previously remarked, the facility of gratifying the passion, and yielding to its frequent impulses, is calculated in a higher degree than any other circumstance, to produce not only peculiarly excitable conditions of the nervous system, but extensive and incurable disease.

CCXLVIII. In studying the nervous matter which gives to the skin its sensibility and all its vital endowments, it is necessary to allude to the intimate relations between it and the brain. This has the power of instantaneously increasing or diminishing its secretions and of modifying their properties. The reciprocal influence between the two is not equally apparent, but is, nevertheless, unquestionable. The evidence of the one falls under daily observation; while that of the other, though less obvious, is an inevitable result. The suppressed cutaneous perspiration, is the occasion of a vast variety of maladies. The skin has no particular relation to any one class of organs. It has the same general connexion with every part of the animal system. The effects, consequent on its derangement, depend on the susceptibility of the viscera, either from the delicacy of their structure or existing vital conditions.

CCXLIX. The consideration of this subject opens a fine and interesting field to the physiologist, nor has the cultivation of it been altogether neglected. The influence of external agents on the skin and on the powers of life generally, were too evident not to awaken attention. Hence the various hypotheses which have been formed to account for the phenomena. Some imagine a peculiar sympathy to exist between the cutaneous surface and the several viscera through the medium of the nervous system: others deny the direct connexion and refer the effects observed to the derangement of the digestive passages. Again, it has been supposed that the brain receives the first impressions and reflects them on the internal organs. Almost all concur in the opinion that on the interruption of the cutaneous functions, the blood retires from the exterior within giving rise to congestion. There is a certain portion of truth in all these views, but they fail in furnishing a comprehensive insight into the nature of the relations between the skin and the rest of the animal economy, and the reciprocal influence which the one is constantly exerting upon the other.

CCL. All parts of the body are clearly associated by two great systems, — the circulatory and the nervous, and a modification in the condition of the one is invariably accompanied with a corresponding change in the other, in which the whole of the vital powers inevitably participate. To illustrate our reasoning, we will suppose the cutaneous exhalation suppressed by cold. The first impression received is on the nerves, existing either as an independent tissue or entering into the structure of the capillaries. The result of this impression is the constriction of the vessels and a diminution of the superficial vital action. Before the blood can be withdrawn from the exterior to disturb the internal organs, certain portions of the nervous system, as the brain, the spinal marrow, or the nerves of the lungs, pleura, peritoneum, stomach, intestines, kidneys, or muscles, sympathize in the disordered distribution of the nervous fluid. This is no longer employed in its usual quantity on the surface of the body, and, therefore, in such ratio will the nervous system generally be affected. The demands on the nervous centres being brought within a narrower sphere, other relations will necessarily arise in connexion with their numerous dependent organs. In the struggle which ensues to conform to new conditions, some of them will receive more and others less of the nervous principle than their usual proportion, and out of these circumstances spring the first elements of disease. Whether it be acute inflammation of any of the tissues, or a morbid state which subsequently manifests itself in the production of phthisis, dropsy, fevers, or other maladies, will depend on the character and tendencies of the vital energies.

CCLI. The attention which is given to the nervous system, is not to the exclusion of the important part which the sanguineous plays in these embarrassed efforts of nature. The blood that was lately in vigorous motion on the surface of the body, is in some degree withdrawn and distributed among the internal organs,—a condition the study of which is replete with highly practical considerations. The blood is modified both in its circulation and quality. The suppressed exhalation from the skin interrupts the escape of certain elements, the elimination of which is imperfectly accomplished by the increased functions of any other organs. The disturbance of the nervous and circulatory systems will derange the whole of the digestive apparatus. The chyle will be less fraught with its ordinary properties. The lungs will, also, be unfavourably circumstanced for the full exercise of their offices. Hence the variety of morbid affections which arise. If the vital powers be exceedingly weak, diarrhœa, cholera, or severe prostration of strength, is the consequence: if vigorous, the greater is the liability to acute inflammatory action. If any of the viscera are already disordered, a new stimulus is added to the existing irritation, the aggravation of which is fruitful in the production of diversified forms of disease.

CCLII. According to these views the skin has no peculiar relations to any particular organ or class of organs. Some of them may be more frequently affected than others on its derangement, but this is attributable to their own rich endowments of vitality and the important functions which they perform. The intimate associations between them, are to be traced to the comprehensive operations seated on two equally extensive surfaces,—the one *internal*—the other *external*. Each has an abundant supply of blood and nervous energy, *and it is these conditions which alone explain the reciprocal influence of the one surface upon the other*.

CCLIII. It is stated by physiologists that when the cutaneous perspiration is interrupted, the kidneys and the lungs, but especially the former, are the eliminators of that which would otherwise have passed off by the skin. The partial suppression of its office does not necessarily require the increased duties of these organs. This doctrine pre-supposes the continuance of the normal activity of the rest of the vital functions. Their depression circumscribes the labours of the excretory organs. The limited action of the cutaneous surface is often a correct measure of a corresponding state of the entire animal economy, occurring occasionally for the wisest of purposes. When from existing disease the ingesta are materially diminished in quantity, or almost wholly withdrawn, nature narrows the outlets for the expenditure of her energies, and thus husbands the resources of the system for its protracted necessities. Were this view fully appreciated in all its practical applications, the treatment of fevers, at their commencement and during their course, would be conducted on principles very different from those which prevail. The study would be to economize rather than to exhaust or embarrass the languid and labouring powers of life. This view has an important bearing in reference not only to this large class of maladies, but to numerous other affections. The boasted activity of our remedies, is frequently far more detrimental than the disease in which they are employed. If the practitioner had the tendencies of the miser in dealing with the vital wealth of others, his success would be much greater, and the exercise of his skill would be accompanied with a higher degree of satisfaction. The general defect of his character, is the want of faith,—save in the value of his own interference. He rarely treats nature with a consideration sufficiently refined, to secure her co-operation in the correction of her own errors.

CCLIV. The supplementary action of the kidneys, which is frequently observed on the suppression of cutaneous exhalation, in cold weather, does not prove that these organs have a more intimate connexion with the skin than the rest of the animal economy. The constituents of the blood not being excreted through their usual channels, continue in circulation, and by their presence stimulate the kidneys and the lungs to increased action. It is through these media only that they can be eliminated without an obvious derangement of the system. If they act upon the bowels and give rise to diarrhœa, no adventitious aid is required.

The interruption of the cutaneous functions, as far as the kidneys are concerned, is equivalent to adding to the circulation an extra quantity of fluid. The apparent sympathy between these organs and the skin,—the augmented activity of the one being invariably associated with a diminution of that of the other, has led to various conjectures to account for the phenomena. The illustrious Broussais, after an elaborate examination of the subject, concludes, that it is not in any degree explicable on the existence of any nervous connexions; and he lays it down as an established fact, that the influence of the suppressed cutaneous exhalation, "is transmitted through the medium of the digestive passages to the tissues secreting and eliminating the urine."* And he further remarks, "that the entire visceral apparatus concurs in the transfer to the kidneys and their dependencies of the irritation which it receives from the skin, at the time that this envelope is subject to the sedative agency of the external cold."† Others have endeavoured to explain the relations on the supposition of a direct nervous connexion. These speculations are not at all required to solve the difficulties. If the necessary amount of the fluid portion of the blood is not removed by the skin, it is evident that it will remain in circulation, and will present itself in its successive revolutions to the kidneys and the lungs, both which organs are the natural eliminators of it. Hence its escape, in these directions, is in accordance with strict physiological principles.

CCLV. There is no condition of the skin more interesting to study, in its relations to the internal organs, than that which co-exists with eruptive fevers. Some of these, especially scarlatina accompanied with sore throat; and the whole of them during their course, when untoward symptoms supervene, exhibit the intimate relations by which the internal and external surfaces are connected. They are in constant antagonism, and each possesses a susceptibility of impressions which is scarcely displayed in any other form of disease. How exquisitely fine occasionally is the balance of the vital energies. A slight exposure to cold,—a trivial indiscretion in diet,—the operation of a mild aperient, or a transitory ruffling emotion, at once changes the fair and encouraging anticipations. The eruption suddenly disappears, and the mucous or serous membrane becomes a centre of irritation, the effects of which quickly undermine the powers of life.

---

* Opus cit., p. 425.

† Ibid cit., p. 438.

It is in these affections that the nervous system is peculiarly involved. When the symptoms are inflammatory, it is in its highest state of excitement. Hence its extraordinary sensitiveness at times to every species of influence, and the facility with which its functions are modified. In no other class of diseases is the animating principle so generally diffused, especially to the surface of the body. The energies which it imparts to the skin, enable it to resist with impunity the frequently sedative effects of cold water and cold air. It is at the decline of these conditions, simultaneously with the eruption, when the nervous system is struggling to conform to an altered state of things,—to re-establish its normal relations and functions, that the vital powers are particularly liable to disturbance. The period of their adjustment is the season of their highest susceptibility of impressions.

The inflammatory symptoms are not alone evidence of the extensive implication of the nervous system in eruptive fevers, the contrary indications, the absence of great heat; or indeed general depression, which is characteristic of some of these, and into which several are prone to pass, are equally conclusive on this point. The nervous power fails to give the required tone to the organization, and hence it presents a variety of manifestations of its inability to carry on the powers of life. The heart contracts feebly; the blood flows in a weak and hesitating stream, as deficient in stimulating properties as it is in vigour of motion. The wide range of vital phenomena are languid and embarrassed.

It must not be imagined that the almost exclusive attention which is here given to the nervous system, is without its practical value. To bring under consideration its derangement, in these and other affections, may appear to present no novelty. This, however, consists not in the enunciation of a general fact, but in the elaboration of the principles with which it is connected. The thorough understanding of these will throw a flood of light on numerous healthy and morbid states. It is surely of great importance to have just and clear views on the vivifying agent of the animal economy,—its varying conditions and laws of action. Truth has always an application, and in directions as well as in a fruitfulness of resources, that entered not into the calculations or visions of its sanguine discoverer.

CCLVI. In the preceding remarks the object has been to exhibit the skin in its relations more especially to external than internal causes. The two, however, cannot be examined apart. To trace the results flowing from the influence of the latter, would necessarily bring under review every disease, whether chronic or acute, or whatever might be its nature: Nor would the investigation be destitute of important practical suggestions. It would open out an endless but not an unprofitable field of research, not simply in reference to circumstances affecting the cutaneous surface. Within such limits it could not be bounded. It would be the analysis of all the phenomena which constitute disease, its origin, character and associations. It would display in a strong light the vast and ever varying conditions of the nervous fluid in the diversities of vital action; and the appreciation of many of its manifestations, rendered intelligible by these inquiries, would awaken attention to symptoms too little regarded in their initial development.

CCLVIII. The attempt to elucidate the functions of the nervous system, and the laws by which they are governed, whatever judgment be formed of the soundness of the conclusions arrived at, will not be without its advantage to science. It has brought before the mind an almost endless variety of phenomena in new and unexpected relations.

The progress of truth, in every department of knowledge, is accelerated by the turning up of fresh soil,—directing the thoughts into unexplored regions, or imparting life and interest to subjects familiar to our observation. Our labours will, at least, have this merit. And in the ratio of their claim on this head will be the difficulties opposed to their reception.

Mankind, with all their overflowing eloquence in favour of truth, hug with far greater tenacity their own immature and unanalyzed opinions. Truth with them is that which they already believe, and not what they are called upon to investigate. The exceptions are the few whose intellectual light merely serves to make the darkness visible.

CCLVII. The comprehensive researches into which we have imperceptibly been led, and the novel views they have elicited, have brought under consideration one subject, which may, perhaps, seem to have no necessary connexion with these inquiries, and yet it flows inevitably from them, *viz.*, *the functions performed by the hair in the animal economy.* That nature gives nothing in vain, though a trite remark, is, nevertheless, a truth pregnant with profound thought; and should be the unceasing stimulus to the restless and enterprising understanding. Nor should the study of what is sublime or lovely, in any of its attributes, lead us to imagine that this was the end contemplated in its production. Though creation abounds in everything exquisite in form, colour and motion, UTILITY IS THE PERVADING PRINCIPLE OF THE UNIVERSE. The beauty with which objects appear to be invested, is not a quality of matter, but a mental feeling. They borrow from the mind the seductive attractions thrown around them, which are designed not only to arouse and gratify its refined susceptibilities, but to lure it to the patient investigation of the objects themselves, their constitution, structure or laws of being. In this view all nature teems with interest, nor has one pursuit a higher claim on attention than another. It is our ignorance of the riches with which each is fraught that makes the distinctions in their value.

CCLVIII. The thorough conviction that utility is the law which characterizes creation, and the peculiar views resulting from our extensive researches into the functions of the nervous system, give to the hair an importance in regard to vital action, which had previously not presented itself to the physiologist. Hitherto no specific office has been assigned to it; nor has it received any attention beyond the examination of its structure and relations to the cutaneous tissues. It is observed by Bostock, that "an obvious use of hair, in the inferior animals, is to protect the body from external cold, but except on the head, this cannot be considered as applying to the human species, nor can we easily conceive what is its object in our economy: yet it is contrary to our ideas of the nature of things to suppose, that what is so constantly found to exist should not be formed for some useful purpose."*

The differences in the quality of the hair in the several races, and its varying amount in individuals, but especially the striking disparity in its distribution, in the sexes, are circumstances which unquestionably prove that it must have some necessary relation to the vital powers. If it were designed to keep certain parts warm, or to protect them from the influence of external agents, a uniformity of condition ought to prevail. If it exercised either of these offices, it should exist in the greatest quantity in those who are the most delicate, whose constitution is the most liable to be disturbed by atmospheric and other causes. In these, however, it is rarely observed to abound in profusion. Its development clearly bears some ratio to the activity and vigour of the powers of life. The modifications which it exhibits from childhood to decrepit age, in harmony with corresponding changes in the animal system, furnish matter for deep reflection. It grows and declines with the progress and decay of organization.

---

* Opus cit., § 52.

Each hair, at its root or bulbous extremity, is in immediate connexion with tissues abundantly supplied with vessels and nerves, circumstances which are replete with interest. "Les bulbes des poils," observes, Béclard, "semblent donc consister en une petite partie de la peau enfoncée, déprimée ou retournée sur elle-même, surmontée d'une papille, *et munie de vaisseaux et de nerfs volumineux* en egard à la petitesse de l'espace où ils se distribuent."* The vitality of all organs may be accurately estimated by the amount of blood and nervous power distributed to them, and whenever this is a remarkable condition, though their functions may be obscure, we may rest assured that they play an important part in the animal economy.

CCLIX. We have endeavoured to establish throughout this inquiry, and especially in a previous treatise,* that a peculiar agent animates the entire of the nervous system; and that the vital properties of all organized matter, are according to the quantity it receives, the distribution of which is constantly varying and permanently modified at every period of life. All organs, within the limits of health, have a ready means of throwing off any excess of the principle. The stomach, the liver, the intestines and all mucous surfaces and glands, by increased secretion, and occasionally by the rejection of their contents. Were the functions they perform accurately understood, or the way in which they correct disordered action and prevent disease, in the ever changing circumstances of living structure, we should discover operations regulated by an exquisite class of laws which have hitherto eluded analysis. These organs, from the offices they exercise, have ample outlets for the often occurring accumulation and disturbing influence of the vivifying fluid. The nervous organs themselves, whose energies are not wasted in ministering to the demands of organic life, or in other words, in maintaining mere animal existence, have equally urgent necessities for a corresponding species of safety valve; or *such means as may enable them to form extensive and vital relations with the great principle pervading the universe.* The hair is designed for one or both of these ends.

---

* Opus cit., §. 335.

CCLX. We shall find, with, perhaps, a single exception, which has other provisions, that wherever there is the concentration of nervous matter, existing especially for the performance of purely nervous functions, NATURE ASSOCIATES WITH THEM THE APPENDAGES OF THE HAIR IN STRICT HARMONY WITH THEIR ACTIVITY.

---

* Philosophy of animated Nature, &c.

Save in the palms, the soles and the lips, it is distributed more or less profusely over the whole surface of the body. Its presence is not required by these organs. Their exercise affords the necessary outlet for the nervous principle. The regions in which the hair particularly abounds, are the head, eye-brows, eye-lids, cheeks, chin, the upper and under lip, pubis, anus, arm-pits, anterior surface of the abdomen, and of the chest, in the male, the inner parts of the thigh and the posterior of the legs.

CCLXI. The only great nervous centre unprovided with hairs, is the spinal marrow, and their absence here may be shown to offer a beautiful illustration of the general correctness of the views assigned to their office. The cord is accompanied with conditions differing widely from those of the cerebrum and the above-mentioned organs. ITS ACTIVITY IS NOT IN RELATION TO FUNCTIONS CONFINED WITHIN THE SPHERE OF ITS OWN STRUCTURE, BUT TO THE DEMANDS OF THE VISCERA AND LIMBS. This is a remarkable difference between it and the brain. The latter has not only corresponding relations, through the medium of the spinal marrow and the cerebral nerves, but is likewise the seat of a vast variety of mental powers, *the operations of which are strictly limited to the nervous* *matter in which they exist.* The spinal cord has its thirty-one pairs of large nerves, originating at short intervals along its whole length, through which it transmits the nervous current to the viscera, the surface of the body, as well as to the superior and inferior extremities, the exercise of which organs furnishes the media for the escape of the animating principle. Whatever opinions be formed as to the soundness of these speculations, the distinctions here pointed out will not be questioned; and, in the following researches it will be shown that they have a value and application worthy of patient study.

CCLXII. It will, perhaps, appear singular that this train of thought, though in no degree suggested by phrenological views, or the arguments of some of the most enlightened physiologists, who regard the mental faculties as seated on the surface of the cerebrum, is not only in perfect harmony with them, but seems to flow as a necessary sequence from the doctrines. That the operations of the mind have an intimate relation to such surface, is established by phrenological and mesmeric considerations, as well as by the phenomena resulting from the structural changes of the investing membranes of the brain; and the opinion is further corroborated by the important fact, that the activity and capacity of the nervous system, whether in reference to the senses or any other nervous functions, *are in the ratio of the surface which directly receives impressions.* In all cases where the power conferred is extraordinary in degree, as in many of the lower animals, there is a striking and peculiar arrangement of nervous matter for the accomplishment of this object. The numerous and deep convolutions of the brain in man are an illustration of one of these provisions.

CCLXIII. The views which are here developed, though strengthened by the opinions entertained respecting the seat of the mental faculties, are, nevertheless, based upon their own particular facts. The hair is in immediate connexion with these faculties. It is not necessary that it should be in juxta-position with their organs to exercise the office assigned to it. Mesmerism clearly shows that the animating principle can be excited independently of actual contact. It would be a waste of time to adduce evidence on this subject. Further, if we consider the common, but interesting phenomenon, that the hair in certain states of the atmosphere, and probably of the body, becomes highly electric, are we to imagine that such a manifestation is in no intimate relation to nervous matter? Is it philosophical to suppose that electricity, existing in all substances is, in this instance, limited to the hair, possessing, as it does, the properties essential to establish the required connexion with the nervous system. *It presents its countless points, either to attract or facilitate the escape of the fluid.* The character of its functions will depend on bodily and atmospheric conditions.

CCLXIV. It may, perhaps, be urged as an objection to this theory, that the hair falls off with the progress of years leaving a large portion of the head bald, consequently to this extent destitute of such provision. It must not, however, be conceived from our reasoning, that its partial absence deprives the nervous centres of the means of establishing the necessary external relations. A man may pursue his ordinary occupations with one eye, or with the imperfection of any one sense, with a maimed limb, or a diseased brain; but it is not to be inferred that their integrity would not enable him to perform his duties with greater ease and satisfaction. The same argument applies to the point in question. And when it is considered that the hair ordinarily continues in great abundance from childhood to the full maturity of the mental powers, and often much later, during which periods the cerebral organs are subject to extraordinary changes, liable to frequent perturbations from the ungovernable impulses of passion, excitement and depression, inseparable from the struggling efforts for distinction, ease or existence, the objection will be found to lose much of its force. Has it any when analyzed in a philosophical spirit?

The decay of the hair arises from the enfeebled vital energies of those parts whence it immediately springs. The nourishment essential to its growth, furnished exclusively by the blood and nervous principle, is either withdrawn from other existing actions, or exhausted through their influence. It may perhaps be urged, that it occasionally falls off when the constitution is sound and fraught with great energy, and in the free exercise of its numerous powers. Hence the views which are here advanced may be regarded as altogether gratuitous. The argument is not without force, but it may be shown to present no formidable difficulties.

If it be imagined that the animal system, at thirty-five or forty years of age, possessing the abounding attributes of health, is characterized by the same nervous and circulatory conditions,—the same fulness and vigour, as distinguished it at a much earlier period, a very erroneous conclusion will be drawn. From birth to the last stages of protracted existence, the myriads of nerves and vessels which enter into the composition of living tissues, are constantly modified in structure and function, weakened in one situation, strengthened in another, adapting them to new duties and fresh demands. All organized matter, from its development to its decline, is a scene of ever fitful action.

The manifestation of mental and bodily phenomena, at the different periods of life, affords a just indication of the diversified phases of vitality, and are invariably accompanied by corresponding structural alterations. Every successive step, from infancy to manhood, is narrowing the activity of the *external* energies, drawing them within to awaken new tastes and necessities, imparting to all the internal organs a greatly augmented current, and, in the same proportion, enlarging the relations of the human being to surrounding objects. *Every degree of these changes* *is a modification of the laws of vital action on the cutaneous surface,* and hence the consequent results,—the decay and grayness of the hair. These are not the only phenomena. There are others not less evident to the acute observer, in the character of the complexion and texture of the skin. Death is a much more gradual process than is generally imagined. It commences with life. The extinction of consciousness is its last triumph.

Baldness offers no objection to our theory. It is indeed in strict agreement with it, and might have been anticipated from the contemplation of the principles here developed. The study of the causes which influence particularly the condition of the hair on the head, would further greatly strengthen our reasoning. Whatever exhausts or powerfully affects the nervous system, whether disease, medicinal agents, or sensual excesses, tends in a remarkable manner to diminish the growth and profusion of the hair. Though this disappears from the temples and upper regions of the head, it invariably remains in considerable quantity at the *posterior*. Is not this fact important in relation to the office assigned to it?

Whatever opinions be entertained with respect to the use of the cerebellum, or the medulla oblongata,—organs seated at the *posterior* region of the head, and from the latter of which the cerebral nerves arise, it is admitted that they are inseparably connected with all the actions of the animal economy. The medulla oblongata whence the nervous fluid flows to co-operate in all the functions of life, and its integrity is essential to existence. Whether the mental faculties be disordered by disease, or the natural progress of age, it performs its important duties with regularity and efficiency according to existing necessities. Their cessation is death. If, therefore, the office of the hair be intimately associated with the activity of nervous organs, facilitating the relations between them and the external world, the invariable presence of this provision, is obviously in harmony with the proposed views, and is an exquisite illustration of their truth.

It may further be remarked, in confirmation of our reasoning, that it shows itself in certain situations, at the commencement of puberty, when the whole nervous system is awakening to a new life,—when every fibre of the animal frame is stimulated by a variety of emotions and feelings. Is it developed on these occasions simply as an ornament? This is not the principle on which nature acts. Utility is the law stamped upon all her works.

CCLXV. It is on these physiological considerations alone, that it is possible to offer a conjecture concerning the changes in the colour and diminution of the hair with advancing years. To some extent they may be regarded as hereditary pre-dispositions, resulting from the influence of circumstances on successive generations. They do not, however, disturb the justness of the broad outline which is sketched. Every severe affection of the nervous system, whether from moral or other causes, produces one general organic state, either immediately or subsequently, *viz.*, *weakened nervous action on the surface of the body.* The animating principle, whether from undue excitement or direct depression, is unequal to the maintenance of vigorous cutaneous conditions; or to employ a more comprehensive term, is inadequate to the demands of its ordinary external relations, and hence the important modifications in all structures which these include.

Profound grief has a sudden and marvellous effect on the colour of the hair. It has been known to be blanched in one night. Such facts are received with incredulity, though less marked degrees are familiar to every one. What is there in the extremes to invalidate them? Whether the phenomena take place in three months, or twelve hours, is equally extraordinary and difficult to explain.

CCLXVI. If anything were required to establish the vital properties of the hair, the change in its colour would be sufficient. They are necessarily possessed by every living tissue, and the manifestation of them is to be traced to the same universal agent, the disturbance in the distribution of which is the occasion of all modified vital action. It holds the whole organized frame in harmonious sympathy. It has the same intimate relations with the colouring matter of the hair, as it has with the mucous membrane of the stomach, with the secretion of urine or any other function; and when withdrawn, whether suddenly or gradually, those chemical elements on which the colour depends are either partially dissipated, or are inadequate to the production of the usual effects.

CCLXVII. Baldness as well as grayness is evidence of a debilitated state of the superficially seated nerves and vessels. In those rare cases of profound grief, in which the mind is concentrated in the depths of its own abstraction, conscious only of the bitterness of its own thoughts, how vast are the changes in the relations of the nervous principle to all structures. The blanched hair falls prominently under notice; but it must not be imagined that this is a solitary alteration. The countenance has lost its fulness, the eyes are sunk and without fire, the heart beats feebly, and the normal course of the powers of life is interrupted. One cause gives rise to the diversified series of results. The nervous fluid is no longer generated in its usual quantity or employed in its ordinary vigorous duties; and what remains has its operations confined within a more circumscribed sphere, leaving the extremities and surface of the body with a greatly diminished supply. Hence the changes in the colour of the hair. It is not unimportant to remark, that this is always first observed in its free extremity, the furthest removed from the stimulus of the nerves,—a phenomenon which corresponds with what occurs in the vegetable kingdom. The remote branches of a tree perish long before the portions more immediately connected with the trunk. They both equally illustrate the same universal law.

CCLXVIII. There are numerous facts which go far to establish the correctness of these views. The profuseness of the hair, in every situation, as a rule, IS PROPORTIONATE TO THE PREVAILING VITAL ENERGIES. These must not be confounded with mere mental activity, or a facility of bodily motions, which may co-exist, and frequently do, but they are not necessary accompaniments. The definition implies a vigorous development of the animal system. The digestive and assimilating organs usually ample and active — the lungs capacious, and every fibre richly endowed with vital properties. The individual is generally a sensualist in the comprehensive meaning of the term. He riots in the enjoyment of the teeming resources of nature. The celebrated Mirabeau was an exquisite type of the class. If the hair be designed to keep the head or any part of the body warm, it is singular that it should be most liberally bestowed on those who have the least necessity for it. If, however, it be a provision in relation to the character of the nervous functions, the variety of its conditions are easy of explanation.

If we direct attention to persons of a leucophlegmatic habit, though to appearance stout and healthy, it will be found, save occasionally on the head, (which is not a necessary accompanying circumstance, the activity of the brain not being limited to any particular temperament,) that the smooth, soft, and flabby flesh, is sparingly supplied with hair. Here again is the constant agreement between it and the vital energies, which, in these instances, are proverbially feeble and liable to numerous diseases remarkable for a deficiency of constitutional tone. If we extend the view and glance at the large class of individuals who, from childhood to maturity, may be described as delicate, or possessing little of the robustness or exuberance of health, it will be observed that these relations almost universally prevail. It may, perhaps, be urged by those who admit them, that their existence does not establish the theory propounded. Will it be argued that the hair performs no essential function? It is not an accidental production; nor are its conditions, with respect to the character of the powers of life, sufficiently capricious to disturb a general law. Everything in creation has its utility, and when we reflect on the quantity and distribution of the external provision, in connexion with the diversified endowments of the animal economy, it is impossible to conclude that it is destitute of a vital office. We are the first to suggest the nature of it, and our attention was drawn to it, not from a liveliness of imagination or a tendency to indulge in loose conjectures, but from a long and laborious investigation of the laws and pervading influence of the nervous system. If we are wrong, we furnish ample means for the correction of our errors.

CCLXIX. We shall now proceed to show that the situations in which the hair particularly abounds, are distinguished by the concentration of nervous matter exercising important nervous functions. The eye-brows and eye-lashes are striking illustrations of the fact. Its presence in these organs may, perhaps, be regarded as protecting the eye from dust and perspiration. It has other and more urgent duties. When we consider the great amount of nervous power in association with the instruments of vision, imparting sensibility and motion to them in a refined degree; and further, the necessity of their action to the well being of man, the external provision is in beautiful harmony with the requirements. The perceptive faculties, agreeably to the views of the phrenologist, occupy the ridge along which the eye-brows are placed, and this may be another, and an equally essential circumstance, demanding the presence of the hair. Its amount in this region varies in different individuals, and will generally be found in accordance with the prevailing character of the vital energies. Observation will discover few, if any, well marked exceptions.

CCLXX. That the face possesses a large quantity of nerves will not be questioned, whether it be studied in reference to expression or the other motory uses of its organs. The acute sensibility of the lips, and their constant play in speaking, eating and drinking; and, also, the powerful action of the jaws in the process of mastication, are conditions demanding a liberal distribution of nervous matter, and the regions in which it exists, *are the most profusely endowed with hair.* The upper and the lower lip, and the angle of the jaws, are peculiarly the seat of it, and it is as strictly a measure of nervous power, as is the sensibility or motion of any part of the body. It is needless to remark, that it is in these situations a general indication of the vigorous properties of the animal system. It is a manifestation of the exuberance of the riches of nature. When do we see in the delicately formed these outward marks of virility and power? The few scattered hairs will often elucidate with considerable accuracy the constitutional peculiarities. It must not, however, be imagined that the comparative absence of them necessarily implies weakness or a deficiency in structural conditions. The individual may be distinguished by strength or agility, hence such an inference would not be just. These corporeal attributes may exist, *and yet may not be accompanied with a redundancy of vital energies prone to sensual gratifications.* It is to these qualities, irrespective of the development and form of the animal frame, that the observations largely apply.

CCLXXI. The human thorax furnishes the next illustration. It would be a waste of time to expatiate on the importance of the functions of the lungs, their co-operation in the chemical changes of the blood; and equally so to attempt to show that their activity is in relation to the prevailing powers of life. There is no part of the body more constantly supplied with hair, in the robust, than the chest; and it is almost as invariably absent or exceedingly deficient in persons who are delicate. In the extensive class of the consumptive, or those pre-disposed to the disease, taking it for granted that neither this nor the tendency to it, has been induced by gross excesses or recklessness of conduct, the chest will seldom be found hairy. The want of capacity is not a more general condition than its comparative smoothness. What then is the inference which flows from this circumstance? Do we not again observe that this external provision which nature has given, is in perfect keeping with the vigour, and hence with the necessities of the animal economy? If its use be to protect certain regions from cold, why should it be conferred in the greatest profusion on those whose character of constitution requires it the least? If we regard it, however, as indissolubly connected with the activity or fulness of the vital energies,—as a medium by which important relations are established between these energies and the external world, modifying, in some mode, the distribution of the animating power, common to both, its function is not less evident than that of the branches and leaves of a tree, the structure and position of which are adapted to maintain corresponding relations with the same universal agent. And let it not be imagined that these are interrupted on the destruction of the luxuriant foliage. The naked arms and crowding twigs present conditions proportionate to the existing demands. Their countless points are spread widely out, fan-like in form, to expose the largest possible surface to the pervading principle of creation, as essential to its diminished sphere of vital operations, as when in the affluence of its awakened resources it produces flowers or fruit. In this view how exciting is the contemplation of the vegetable kingdom in the season of its repose; and how various are the speculations which the study of it opens upon the inquiring understanding.

CCLXXII. The hair on the chest frequently gives indications of electricity, and it is not irrational to suppose that it may have some necessary connexion with the aerating process of the lungs. The fact, in reference to the theory proposed, is replete with interest. Its occurring only in certain conditions of the atmosphere, is no objection. It is perhaps these conditions, not at all understood in their relations to surrounding objects, that may peculiarly call into play this external provision.

CCLXXIII. There is a striking difference in the distribution of the hair on the posterior and anterior parts of the body. It is often found in considerable quantity on the abdomen, as well as on the chest. The surface of the former may be said to be in contact with the greater part of the chylopoetic viscera, and hence, even in regard to these, it may exercise a particular function. It certainly abounds in the ratio of the existing vital energies.

We have, in a previous page, pointed out an important distinction with respect to the necessity of the hair in relation to different organs, which it is essential to keep in mind. It may not be imperatively wanted by those, which, from the nature of their offices, can readily relieve any undue excitement or nervous derangement, within certain limits, by their increased action, as the thoracic and abdominal viscera. The head, the face and other regions of the body, are differently circumstanced. The mental operations are *confined* to the brain, the animating principle of which being subject to extraordinary modifications, from the influence of moral and other causes, necessitates the existence of such a provision. The same argument is applicable, in a lesser degree, to other organs in which the nervous functions predominate. According to this view, we should not expect the anterior surface of the thorax and abdomen to be profusely covered with hair.

CCLXXIV. There is another region in which this is always found, and where a large amount of nervous matter exists, *viz.*, the axilla. It is the seat of an extensive plexus of nerves composed of the four lower cervical and the first dorsal, from which the arm, hand and fingers, the shoulder joint and several muscles, are supplied. From this source they derive the power of motion and sensibility. Again we observe that this nervous condition is accompanied with hair; and, when we consider it in relation to its immediate organs, liable to violent action in the various pursuits and occupations of life, it appears to have here its appropriate and necessary function. The degree in which it abounds, in this situation, is in harmony with its general prevalence, clearly showing that if it exercise an esential office in one region, it must equally in another. If it be an external appendage without any specific use, it is singular that it should have such remarkable relations to the character of the vital powers. Were the distribution of it the same in the delicate as the robust, it would be in vain to attempt to connect it with any constitutional peculiarities.

cclxxv. The pubis, in both sexes, is copiously endowed with hair. The parts in its immediate vicinity are possessed of extreme sensibility, consequently are liberally furnished with nerves. It is not necessary to particularize the extraordinary changes of condition to which they are subject. They need no elucidation. There is no region, save the head, where the co-operation of the external provision is more imperatively required than here. It is associated with organs ministering to the gratification of powerful instincts, and its profuseness will be found to be in the ratio of the innate vigour of the vital operations. Concerning any other office that it may, with propriety, be supposed to exercise, we shall from obvious reasons make no remarks. This would not, however, explain its action in other situations.

cclxxvi. Hair, in the male, is developed around the external parts of the anus. Its absence in the female, may possibly appear to militate against the use assigned to it. The further consideration of the subject will, nevertheless, not only remove any objection arising from such discrepancy, but will tend in a peculiar manner to confirm the justness of the views propounded. This, and other extraordinary differences between the sexes, will throw great light on the influence of important organs in the animal economy. The function of the sphincter ani implies the existence of great nervous power, and in especial relation to the spinal marrow. Its permanent constriction is overcome only by the occasional urgent necessities of nature.

CCLXXVII. The entire surface of the body, with few exceptions, is covered with hair, and though in many individuals it is too fine to arrest attention, in others it is exceedingly apparent. It, also, abounds the most in those situations which are subject to frequent or violent action, as the superior and lower extremities, and particularly over the large muscles brought into play on the *posterior* region of the limbs. And further, it is found to prevail in greater quantity in those whose occupations are active, than in persons engaged in sedentary pursuits. Compare the legs of those whose daily business it is to walk great distances, with others, strangers to the exercise; or the arm and hand of the man who wields a heavy instrument with one independent of labour,—supposing the temperaments or constitutional characteristics of the individuals to be similar, and a striking difference will at once be evident. In all these cases we perceive an illustration of the law laid down, in reference to the function of the hair. *The quantity is generally proportionate to the existing vital actions.*

We are fully sensible of the difficulties of this inquiry. Were they not inseparably connected with it, the present train of thought would not have been the first attempt to explain the function of this widely pervading external provision. We should have had the advantage of the observations of others to guide or enlighten our investigations. The subject, however, has hitherto been a virgin soil in physiology. It has been as little cultivated as if it had not had an existence. On this ground our views have some claim to indulgence. Not that error should receive favour, but that speculations, on an untrodden path of research, should be treated in a candid and liberal spirit. A distinguished writer observes: "it is difficult to assign a plausible use for the hair. That of the head has already engaged our attention: but the hair which appears on certain parts at the age of puberty, and not till then, and that on the chin and upper lip of the male sex only, set our ingenuity at defiance."* Whether we consider sex, age, temperament or other circumstances, it is too generally distributed and associated with constitutional peculiarities, not to perform some vital duties.

This provision cannot be ascribed to a capricious freak of nature. To any fortuitous action of organic elements. It is in intimate union with the nervous system in its superficial or external relations, influencing the distribution of the nervous fluid, by which the balance of the powers of life is on ordinary or extraordinary occasions, maintained. It is, therefore, evident that wherever nervous matter abounds, whether as a centre, confining within itself important operations, or whence nerves radiate to other organs; or indeed whether we examine the external surfaces, which are either the seat of or in the immediate vicinity of extensive vital processes, it is found, as a univeral law, that the hair is proportionate to the activity of these processes, and that the quantity, in different individuals, is not only in the ratio of the innate vigour of the animal system, but is likewise augmented in particular regions by the stimulus imparted by exercise.

---

* Professor Dunglison, M.D., opus cit., vol. I., p. 106.

CCLXXVIII. The reader, in analysing the foregoing views, will necessarily have his attention frequently arrested, by the obvious and apparently perplexing question, how will the writer deal with the diversities between the sexes in regard to this presumed provision? The female has not the masculine attributes of the beard or the hair on the chest. She has the luxurious softness of the skin and the swelling prominence of the breasts. These are some of her peculiarities. She is cast in a finer mould, and differs not less in the character of her mind than in the delicate structure of her frame. The mental and bodily qualities of the two are widely dissimilar, and the conformation of each is fitted for its special offices;

and though exceptions may present themselves to any broad line of distinction, they do not disturb it. She is less in stature, her bones are proportionably more slender, the muscles by which they are clothed are less developed, her limbs are rounder, the chest less in capacity, the lungs less active, and their functions are much less often aroused by the pleasures and pursuits of life: the hips and the abdomen are relatively larger, the heart is smaller, and the arterial current less stimulating and vigorous. The important nervous centres and their numerous nerves, are less than in man, and her brain varies from his not less in form than in the tendencies and range of its faculties.

These are some of the circumstances by which she is distinguished. *They all, save, perhaps, those associated with the sexual functions, imply a correspondingly more limited amount of vital action:* and were we to leave out of consideration other diversities, these alone, according to the theory propounded, would lead us to calculate on dissimilar cutaneous conditions. In none of the regions previously contemplated, have we the same quantity of nervous matter, consequently the phenomena, characterizing its operations, should be in perfect harmony with it. Such is indeed the case. These differences, however, will not explain the comparative absence of hair in certain situations. We must look to other and more influential causes for its elucidation, the analysis of which, if successfully conducted, will be shown to accord with the whole of these inquiries.

CCLXXIX. The organs, peculiar to the female, when maturely developed, impart to the animal system a distinctive character, by bringing into efficient play extraordinary powers of action: in other words, *there is an entire modification of every function.* If we imagine that their influence is confined to the sphere of their own immediate operations, we shall entertain a very inadequate view of the vast field of vital phenomena, their source, nature and causes of disturbance. The addition of these organs constitutes the creation of a new being, in many respects like the male, but not precisely in any one particular. The senses and all the instruments of life, may perform the same general offices, but they will differ from his in force, tone, effect, or comprehensiveness of action. The uterus and the mammæ have their associated nervous conditions, which permanently change the distribution of the blood and nervous energy, not in certain regions only, but throughout the whole frame: and on this view we shall be able to account for the differences between the sexes in regard to the external provision of the hair.

CCLXXX. Until the age of puberty the salient peculiarities of the sexes, in reference either to body or mind, are not well marked. They have the same soft and downy skin. The awakening influence of the generative system creates fresh centres of activity. The breasts of the one are enlarged. The vocal organs of the other are strengthened; and with the exercise of the aroused functions, the hair appears on the pubis of each, but on the face and chest of the male only, as well as in increased quantity on the cutaneous surface generally. We thus perceive that the creation of new vital processes, and the stimulus they impart to the powers of life, *are invariably accompanied with a proportionate change in the character of the external provision.* Why this is not equally apparent in the face and on the chest of the female, is readily explained on the principles here laid down. If the augmented vital action of any part of the body gives rise to the growth of the hair, whatever tends to enfeeble this action in any particular region, from the presence of organs in the one sex, which are absent in the other, should according to the same reasoning be followed by corresponding effects. THE MAMMÆ AND THE UTERUS ARE THE ORGANS WHICH MODIFY THE CONDITIONS OF THE SKIN. They draw to themselves the blood and nervous energy essential to their development, which in the male are largely distributed throughout the animal system. The new life which they excite in their own immediate regions, produces the remarkable alteration in the form of the bust, the hips and the neighbouring parts, which so materially heighten the attractions of woman.

These extraordinary changes cannot take place, except at the expense of the two systems,—the circulatory and the nervous: nor can they occur in certain regions, without a less amount of blood and nervous energy being necessarily left to invigorate the functions of the skin, as well as of other organs. The comparatively feeble *external* actions are the cause of the predominance of the adipose tissue in the female, giving to the limbs their beautiful rotundity, and to the rest of the body its fulness and softness. The deposition of fat is more frequently observed in the other sex, after the prime of life, when the prevailing vital processes become similar in character. Its presence invariably indicates a proportionate decline in the amount of blood distributed to the cutaneous and subjacent tissues. The capillaries diminish in number and activity with its gradual accumulation, and everything that weakens their energies, such as ease of mind, slothfulness, long hours of sleep, inactivity of body, and particular articles of diet, accelerate this condition of the external parts. Numerous facts may be adduced in illustration of this truth.

A tendency to obesity frequently occurs in infancy and childhood, and far more generally in those of a scrophulous or leuco-plegmatic habit, than in the nervous and muscular. The vital powers of the former are proverbially deficient in tone and vigour. In man, and in many of the higher classes of animals, it is mostly accompanied with a striking alteration in the quality and quantity of hair. In horses, how sleek and fine the coat becomes when they arrive at a point a little beyond that which fits them for active exercise, compared with the ill-fed, but equally well-groomed. The change, however, is most obvious in swine. There is a marked diminution both in the number and strength of the bristles, during the process of fattening. And in those, which, from their breed, are peculiarly disposed to it, the cutis is remarkably free from them. In the wild state, in which the animals are impelled by urgent necessities to go in search of food, and often procure it with great difficulty, we perceive very dissimilar conditions of the cutaneous tissues. The bristles are numerous and of great strength. They are evidence of a corresponding difference of the entire organization. The active exercise, and the stimulating, rather than the feeding qualities of the ingesta, are circumstances which impart a high degree of vitality to every region of the body. Hence the character of the *external* provision is in harmony with the induced actions. Whenever these are modified by the interest or culture of man, a proportionate change invariably takes place in the endowments of the skin.

CCLXXXI. The foregoing explanation of the organic conditions of the human female, and the accompanying functional phenomena, will not be questioned. Their relation to each other is too intimate and evident to be matters of doubt. The diversities, therefore, with respect to the development of the hair in the two sexes, are fraught with no insuperable difficulties. The proposed theory is equal to their solution, nor is there anything forced in its application.

CCLXXXII. These views are further confirmed by other facts and considerations. If the development and activity of the mammæ and uterus modify the growth of the hair, it is natural to suppose, that the *cessation* of their functions would, in some degree, affect the conditions of the *external* surface. Not that the withdrawal of their influence breaks down the distinctions in the tone and energy of the vital powers of the two sexes. This is not possible. *It approximates, nevertheless, the one to the other, by certain extraordinary phenomena.* The face of the female, that had previously its scarcely perceptible down, frequently indicates, at the change of life, the unquestionable presence of hair, especially on the chin and upper lip, which increases with age. Whilst it is becoming thin and gray on the head and other regions, it is often unequivocally displayed in those situations, *as if its growth had only been suspended by the activity of the generative apparatus and its associated organs.* These having ceased to draw to themselves the blood and the nervous principle, the circulatory and nervous systems adapt themselves to new conditions, and one of the numerous results, *is the appearance of hair, which is singularly corroborative of the proposed theory.*

CCLXXXIII. There is another phenomenon which illustrates the influence of the generative system in the female. In man, the external parts of the anus are provided with hair. In woman, it does not exist. Its absence here, as in other situations, *is to be ascribed to the controlling agency of the uterine system.* This, as already observed, imparts not only a distinctive character to the functions of life generally, but affects in an especial manner those of adjacent structures. Hence this difference between the sexes. The circumstance is exceedingly interesting in this point of view. It clearly shows that extensive vital actions peculiar to the one, exert an extraordinary influence on the conditions of the skin. In this instance, they prevent the growth of the hair in a region which in man is endowed with it.

CCLXXXIV. According to the train of reasoning here pursued, the distribution of the hair, in the female, is in perfect relation with the nature of her vital energies. Her nervous system is less developed, and much less active in reference to the digestive, oxygenating and assimilating processes; and is also much less frequently excited by the stirring pursuits, the laborious occupations, and the free or generous living of the male; and, therefore, if the external appendage perform an important function in connexion with the nervous principle, or the aroused and vigorous conditions of life, it is clearly less imperatively required by woman. If, however, in addition to these circumstances, which none will question, we take into account the existence and operations of the uterus and its associated organs, all centres of powerful nervous action, and exercising an influence on every fibre of the body; there are other causes, which conjointly with the foregoing, are amply sufficient to explain the diversities in the distribution of the hair.

These principles and the arguments by which they are supported, we leave to the candid consideration of the inquiring and enlightened mind. If they fail to enforce conviction of their entire soundness, they will have the merit of investing a subject, hitherto unapproached by the physiologist, with no ordinary interest. Nor will it be denied that the investigation has brought into prominent notice, certain relations between the conditions of the vital powers and the hair, to which attention was previously in no degree directed. It is trite to remark, that truth is always valuable and fraught with important applications. This is its universal law. Every approximation towards it, is enlarging the boundaries of knowledge and giving to man a wider sway over nature.

These views will be found to have an intimate bearing on the conditions of the skin, whether characterized by disease, baldness or grayness. In the present stage of the undertaking, it would be premature to offer any suggestions on this head. Several will readily present themselves to the scientific practitioner.

CCLXXXV. We shall further attempt to elucidate another remarkable difference between the sexes, which is alone explicable on these principles. Woman is much less liable to baldness than man. The hair frequently becomes thin after the prime of life, but it does not generally leave large spaces of the scalp uncovered; nor does it, as a rule, become gray so early, or to the same extent, as in the male. This is sometimes said to arise from the solicitude of nature to preserve the attractions of the female. It is certainly pleasing to contemplate her in this light,—an object of especial care; and an ungracious task to disturb so grateful an illusion. But if her beauty were a particular consideration, why does nature allow it to depart from the eyes, the features, the complexion, and the limbs, which lose the ease and grace of motion; or indeed from the mind, playful and spiritual in its manifestations in the maturity of her charms? She is, however, obedient to the laws of her organization, and unfortunately is not exempt from any of the evils inseparable from living structures. Every effect has its specific cause, and the discrepancy between the sexes, in regard to the conditions of the hair, may be shown to be in accordance with a corresponding difference in the prevailing character of the powers of life.

CCLXXXVI. We have in the foregoing pages illustrated the influence of the uterine system and mammæ, on the form and diversified functions of the body. These are centres of action peculiar to the female, and the further analysis of them will show, that the less tendency to baldness and grayness is to be ascribed to their controlling agency. Man, in the full exercise of his powers, has no organs which may with propriety be designated SUPERNUMARY. All his endowments are essential to his existence, the gratification of his feelings, and the performance of his various duties. When he has attained his prime, exhibiting the vigorous play of the abounding and elastic energies of life, the silent and unperceived steps of decline gradually steal upon his frame. The intimations of its progress are some time before they awaken attention.

They at last tell their story, and in language that differs in each individual, according to constitutional peculiarities, the occupations that have formed either the business or the pleasure of existence, and the habits that have been the rule of his conduct. The commencement of the season of decay, IS NOT CHARACTERIZED BY THE CESSATION OF ANY FUNCTIONS, WHICH, HAVING ACCOMPLISHED THE SPECIAL END FOR WHICH THEY WERE DESIGNED, WITHDRAW THE VAST INFLUENCE THEY HAVE EXERCISED. There are no organs endowed with such functions. Did they constitute a part of his system, their operations and subsequent change would have their appropriate manifestations, definite and intelligible to the observer. Woman has these organs. The transition from the full enjoyment of her powers to the subsiding susceptibility of the uterine system, is marked by phenomena widely different from those which distinguish man. The uterus and the mammæ gradually decline, as centres of activity, setting, if the term may be allowed, the blood and nervous principle at liberty, to minister to the general necessities of the body. They make no demands upon either, consequently the animating agent, thus relieved from its local engagements, whether of a periodical or occasional character, *may be regarded as an addition to what already exists, performing other offices.* Hence the interesting fact, that on the cessation of the uterine functions the hair frequently appears upon the chin and lip. Its development, in these regions, is an extraordinary illustration of the truth of these views. The nervous principle that was previously called into play by the requirements of the uterus, being freed from the duties associated with its operations, becomes inevitably the property of the animal system at large. It, also, follows that the several structures, which had been most influenced by the temporary vital conditions of this organ, will be the most obviously affected by its virtual destruction, and these are the skin and its endowments. The growth of the hair on the face, shows that a new or greatly invigorated action is induced. It is indubitable evidence of increased vital energy on the cutaneous surface. Plants are not rapidly developed, except at the expense of a proportionate augmentation of the elements of nutrition. The pervading agent by which these are combined and fashioned into various products, must exist in the living tissues. This is a law of nature, and it is displayed equally in the animal and vegetable kingdoms. Then whence is derived the vitality that strengthens the growth of the hair on the face of the female, at and subsequent to the change of life? Is it an effect independent of a cause? What produces the difference between the sexes, at this period, in regard to this external provision? The answer clearly is, THE CESSATION OF THE UTERINE SYSTEM AND ITS ASSOCIATED ORGANS. The interruption to their demands, is equivalent to an addition of the animating principle to the cutaneous structures, and its presence is manifested by the remarkable phenomena which fall under observation.

CCLXXXVII. If such an alteration in the play of vital action gives rise to the growth of the hair, in particular regions, it is easy to explain why woman is less frequently bald or gray than man. At the time when these changes take place, in the latter, *they are arrested, retarded or modified, in the female, by the greater or longer sustained activity of the skin, arising from the cessation of the uterine functions.* We have here a striking dissimilarity in the effects, and a corresponding difference in the causes in operation. The conclusions are established by the strictest rules of philosophical analysis. We have pointed out the distinctions in the conformation of the two sexes: have shown that there are organs in the one which are not present in the other, and have elucidated the peculiar influence they exert on the structure and functions of the body; and lastly, have remarked, that, at the decline of life, in the female, (when the most important of these organs may be regarded as virtually withdrawn, as centres of extraordinary activity,) a material change is induced in the conditions of the whole nervous system, which has no parallel in man. These are unquestionable facts, and though they have never been examined in these varying aspects and relations, they rest, nevertheless, on a basis which no subsequent investigations can disturb.

CCLXXXVIII. The extensive view of the vital powers which are here brought under notice, is not less interesting as a study to the enlightened physiologist, than it is important from the practical suggestions with which it is fraught. We cannot, however, afford space to exhibit the value and application of these to medicine. The consideration of them does not belong to this particular branch of inquiry.

CCLXXXIX. It may possibly be urged, as an objection to the preceding arguments, that as the hair is frequently observed on the chin and upper lip of the female, at the change of life, but more especially at a later period, that its *growth* on the head should be an accompanying phenomenon. This could scarcely be seriously advanced. Its appearance on the face is not the universal rule, except, perhaps, in an exceedingly refined degree. Its presence, however, is sufficiently general, and occasionally so evident, as to have arrested the attention of the most careless observers. The influence of the uterine system, in its *highest* activity, on the structure and functions of the body, varies in a remarkable manner in different individuals. In some it imparts new energies to every fibre; diffuses a bland and grateful stimulus throughout the animal economy, the effects of which are displayed in the improved complexion, the soft and well-rounded limbs, the finely developed bust, and, indeed, in all parts which constitute the peculiar attractions of the female, not omitting a change equally great in her passions, feelings, and tastes. In others the influence of the same system produces very different results: it awakens no life in the tissues, but on the contrary acts prejudicially on that which they possess. So far from responding to the new sphere of vital action, and co-operating energetically in the accomplishment of the intentions of nature, the countenance wears a haggard and anxious appearance, the neck is lean and shapeless, the breasts are scarcely prominent, the exterior of the body and limbs are equally affected, showing that the aroused energies within are incompatible with the healthy and vigorous operations of the animal system.

CCXC. From these considerations it is clear, that results, equally diversified, will arise on the cessation of the uterine system, in different individuals, and particularly in regard to the development of hair. This, of course will, also be affected by constitutional tendencies. The manifestation of it will often be found to be a just indication of the strength of the animal passions. This would be anticipated from the mode and degree in which they influence the powers of life. Their agency is not confined to the brain. They stimulate the generative organs, (with which they are intimately associated, occasionally deriving from them an ungovernable impulse,) awaken the whole nervous system, and consequently are peculiarly calculated to excite the cutaneous surface to increased activity.

CCXCI. These views are further corroborated by the conditions of the eunuch. Emasculation closely assimilates him to the character of the female. His arms, thighs, and legs, have little of the muscular attributes of his sex. They are generally soft, smooth and round; and his face never displays a profusion of hair. Here again we perceive the most intimate relation between this external provision and the state of the generative organs. If the operation takes place subsequent to the appearance of hair on the face and chest, this will gradually become thin, fine, and at length will almost entirely cease to grow. These, and similar facts are too well known to require any lengthened remarks. They are, nevertheless, of great value in connexion with the present investigation. Were we to examine the distribution of it in many of the lower animals, the modifications which it exhibits from a difference of sex, organization and propensities, a variety of additional evidence would crowd upon the mind in confirmation of the general correctness of the theory propounded.

CCXCII. If the principles laid down rest on the broad basis of truth, they have an application to the whole of animated nature. They are not limited to the elucidation of one particular external provision. They penetrate far deeper into the laws regulating the development of organic structure, and are calculated to throw light on a wide class of phenomena, which have hitherto eluded the analysis of the physiologist.

CCXCIII. The principles have a reference to every phase of human existence, to every change whether of mind or body, from the first stirring impulse of life to its protracted duration. If it be imagined that they are confined to the consideration of any one property of the animal system, their scope and tendency are imperfectly understood. They have a relation to all the vicissitudes of being. They necessarily bring into prominent notice the diversified actions of organic structure, the mode in which they are influenced by age, disease and other circumstances, exhibiting vital phenomena in all their importance and variety of conditions. The elaborate study of these led to the suggestion of the use of the external appendage; and whatever may be thought of the justness of the conclusions arrived at, it will not be denied that the views have some claim to attention. They are not founded on gratuitous assumptions, but clearly establish that the quantity and distribution of the hair are in harmony with the prevailing powers of life, modified by the local and general changes to which these are subject; and no subsequent discoveries can invalidate the numerous and interesting facts brought forward. The only point which is vulnerable or in any degree open to objections, is in ascribing a *particular* function to the hair in connexion with these powers. When we consider the manifest wisdom displayed throughout the works of creation, the exquisite adaptation of means to ends in everything that falls within our comprehension, it is unphilosophical to suppose that the hair performs no specific office. Though its nature be not so obvious as that which is exercised by the leaves of a tree, it is equally unquestionable. Like these, its luxuriance and decline vary with the modifications of vital action.

CCXCIV. We are not insensible of the difficulties opposed to the reception of novel views, based on the existence of a nervous agent, susceptible of accumulation and dispersion, to the influence of which all vital phenomena are to be traced. The age is not prepared for refined researches of this character. The constant demand is for something which is designated practical, as if the study of the laws regulating the operations of the animal economy, were not the only foundation on which large and accurate theories can be built, having an immediate relation to the treatment of all diseases. Medical science certainly offers an inexhaustible field for cultivation, and in departments much less abstruse and embarrassing than the one engaging our attention, but which have been almost entirely neglected. Among these, the first in importance, are the conditions of the circulatory system, *at the different periods of life*, and as modified by a variety of external and internal causes. Where shall we turn for information on these subjects? Unfortunately our own labours are almost the only attempts that have been made to elucidate them.* Were they understood in all their practical bearings, the present inquiries, contending for the existence of a widely pervading nervous agent, would be received in a spirit very different from that which may await them.

---

* See the Laws of Organic and Animal Life, &c. 1829. The Philosophy of the Moving Powers of the Blood. 1844.

The further consideration of the hair and other external endowments, as provisions associated with the operations of the vital energies, throughout the vast range of animated nature, will depend on the encouragement given to these efforts.

CHAP. II.

THE LAWS AND NATURE OF SYMPATHETIC PHENOMENA.

SECTION I.—SYMPATHETIC PHENOMENA ORIGINATING IN A MODIFICATION OF CEREBRAL ACTION, INDEPENDENTLY OF IMMEDIATE EXTERNAL IMPRESSIONS.

CCXCV. Few subjects in physiology have attracted greater attention or been more elaborately studied, than sympathy. It has been investigated by minds of the first order, and in some cases with a degree of success which renders it remarkable, that juster and more comprehensive views have not been entertained on its origin and nature. The fault is attributable to the limited knowledge possessed on the functions of the nervous system. If this had been regarded as animated by a principle susceptible of accumulation and dispersion, and as constantly influenced by a variety of causes, the efforts of the inquirer would have been distinguished by more satisfactory results. It is on the presence only of such an agent, liable to frequent modifications in its distribution, that it is possible to explain sympathetic affections. It is singular that those who have advocated its existence, have not attempted to elucidate the mode in which it acts in vital operations. We shall in vain consult the highest authorities for any steady and clear light on this intricate and important investigation. The extraordinary discrepancies of opinion which prevail, are striking evidence of the accuracy of this assertion.

CCXCVI. Numerous hypotheses have been advanced to account for the phenomena of sympathy. The blood-vessels have been regarded by some as the media for its transmission; others have ascribed this office to the ganglionic nerves or system of the great sympathetic; by Whytt, Monro and others, it is attempted to be traced to sensations: it has, also, been referred to the contiguity or continuity of the sympathizing organs; or to a similarity in their structure or function; and lastly, it has been argued that the respiratory nerves are the channels through which the influence is conveyed. On the merits of these and other doctrines, we shall not, at present, dwell. Some of them contain a large portion of truth, but are inadequate to the explanation of the diversified effects which fall under observation. They equally fail to present a comprehensive view of their origin and nature; nor does the information which they furnish elucidate the source, character or treatment of diseases. The following extracts from distinguished authorities on this subject, show how much remains

to be accomplished. "La cause organique des sympathies n'est pas encore bien approfondie, et il faut avouer que nos connaissances sur ces sympathies se bornent, jusqu' à présent, a savoir moins ce qu'elles sont que ce qu'elles ne sont pas."* Georget remarks, "Aucun sujet de physiologie ne présente autant d'obscurité, n'est moins avancé, que celui des sympathies, des rapports, des liaisons organiques ; ce sont les *mysteres* de la science."†

Dr. Fletcher observes : "in regard to the *manner* in which the stimuli of sympathy and passion or instinct are conveyed—whatever be the *channels* through which they pass—we are almost entirely in the dark."‡

CCXCVII. Our previous studies devoted to the investigation of the nervous system, will, perhaps, enable us to diminish the mysteries in which this important inquiry is involved. If we presume to see further than our predecessors, the advantage arises from their accumulated labours, and the concentrated attention given to one particular train of research. This, indeed, is the secret of all success in scientific pursuits. Nothing is done well except in detail, and nothing is trivial or unfruitful in valuable results to which the mind judiciously directs its energies

CCXCVIII. The mode in which we propose to examine the phenomena of sympathy, will bring under consideration almost every species of vital action, or at least the laws by which they are governed. We shall at first analyze the phenomena originating in cerebral changes in connexion with thought and emotions, not necessarily arising from immediate external causes: secondly, as they present themselves from external influences disturbing the functions of the brain; and lastly as they occur in different parts of the animal system without the obvious co-operation of this organ. In this manner we shall embrace the wide field of sympathetic affections, and the inquiry will tend to elucidate a variety of vital conditions.

---

* Adelon, opus cit., tome IV., p. 262.

† Physiologie du systéme nerveux, tome II., p. 32.

‡ Rudiments of Physiology, Part II., *b.*, p. 67.

CCXCIX. In order to have a clear conception of the source and nature of sympathy, it is essential to regard the nervous system as pervaded by one animating agent, flowing from the brain and spinal marrow to every molecule of organized matter: the nerves, whilst they are the connecting media, are, also, the channels for the distribution of it. All nerves, whether instrumental to the senses, to motion or feeling, are equally endowed with it. *The diversity of their functions depends on a difference in their peripheral and cerebral relations.*

CCC. On any of the prevailing doctrines it was impossible to discover the laws of sympathetic action. The study of the different structures could throw no light upon them. The views which Whytt and his followers have laboured to establish, have made the nearest approach to a knowledge of these laws. And why? Because they brought into prominent notice one of the causes the most influential in the disturbance of the nervous fluid, viz., *sensation.* This was too intimately associated, as an antecedent with an evident sequence, not to arrest the attention of the philosophic mind. But alone it was inadequate to the explanation of sympathetic phenomena. How much more clear and comprehensive would have been the reasoning to which it gave rise, had the consideration of it been based on the existence of a nervous principle. Independently of this it is not possible to furnish a rational theory of the mode in which sensation produces its diversified results. Whatever may be its character, it implies necessarily a change in the conditions of the nervous agent, and hence in the action of a variety of nerves, which, from their position, are immediately affected by the predominant feeling. If this be exciting, we have evidence of the additional stimulus conveyed to different organs: if depressing, the effects of a diminution of it. If we regard the brain, in its relations to the countless series of nerves, in the light in which the heart is connected with its myriads of vessels, we shall, in some degree, have a just notion how every modification of cerebral action is inevitably accompanied with corresponding external manifestations. The two will admit of further comparison. We may in various ways disturb the functions of the capillaries, locally, without directly influencing the heart; and we shall subsequently show that numerous changes in the nerves themselves may occur, giving rise to sympathetic phenomena without immediately implicating the brain, or at least to an extent which is appreciable.

CCCI. It is difficult to give an exact definition of sympathy, as is evident from the attempts which have been made. This arises from the very different causes in which it originates. Were it invariably to be traced to sensation the task would be comparatively easy. The instances by which it is peculiarly indicated are familiar to all. Sickness or vomiting in the early stages of utero-gestation; sneezing from irritation of the nostrils; the contraction of the iris from the impinging of light upon the retina; the excited or depressed condition of the organs of generation, from particular mental feelings; the immediate disturbance in the functions of the heart, stomach or liver, from emotions; the enlargement, and occasionally acute sensibility of the mammæ, from the awakened activity of the uterus; yawning, sighing and hiccup, and numerous other cases may be given as illustrations of sympathy. It may be defined AN INFLUENCE EXERCISED BY ONE ORGAN UPON ANOTHER, INDEPENDENTLY OF VOLITION, FROM MODIFICATIONS IN THE ACTION OF THE NERVOUS PRINCIPLE. Hence all sympathy depends exclusively on the nervous system. This view will enable us to explain the manifestation of its phenomena, in situations and under circumstances, which have hitherto embarrassed the physiologist. An approximation to a knowledge of the laws, according to which they are developed, can be arrived at only by studying the causes which modify the distribution of the nervous energy.

CCCII. We shall first examine the influence of the brain exerted spontaneously, or, in other words, independently of immediate external impressions, on different parts of the body. Every train of ideas has its corresponding expression of countenance. This may occasionally, in some persons, be difficult to read, it nevertheless portrays the general character of the mental feeling, the successful interpretation of which requires only acuteness of observation equal to the art which is employed to conceal it. In the most elaborate and subtile efforts to disguise the thoughts, exhibiting, at times, the most perfect simplicity of manner, a something is always manifested,—it cannot be constrained, and receives additional significance from the very attempt to keep it out of view.

The constant play between the features and the cerebrum, is an interesting object of investigation, and the thorough understanding of it will throw light on the nature of all sympathetic affections. It will not be doubted that the relations between the two, depend on a multitude of nerves connecting the sympathizing organs; or that the nerves are the channels through which flows the nervous fluid in harmony with the prevailing feelings. The latter will scarcely be regarded as an hypothesis after the previous elaborate researches. The operation of a principle giving life and energy to the nervous system, and susceptible of a variety of changes, at one moment increased, at another diminished in its amount, will not be questioned. We might almost with as much reason doubt the circulation of the blood. It is, therefore, easy to explain the indissoluble union between the organs of expression and the diversified states of the brain. Every train of ideas sets in motion the nervous fluid according to the degree of its vivacity. If exceedingly lively, though unexcited by immediate external objects, the nerves convey the awakening impulse to the eyes and every feature. The whole countenance displays the grateful influence of the passing thoughts. Or if these be gloomy or depressed, how grave and desponding are the outward indications. The muscles are no longer in fitful action. The spirit by which they were lighted up, is concentrated within. It has narrowed its *external* relations. In the one case, the sensations imparted an additional stimulus not only to the nerves of expression, but to every part of the animal frame: in the other, the nerves cease to transmit it in its ordinary invigorating stream, and hence the remarkable changes in the play and energy of the vital powers. Similar effects are produced by dreams, when the mind is altogether withdrawn from the stirring agencies of the wakeful world. These phenomena are alone explicable on the existence of one widely pervading nervous power.

Professor Alison, in treating of the nature of sympathetic actions, observes "that these actions most generally depend on the excitation of particular sensations. *In order that these sensations may be felt,* the nerves, from the impressions on which they proceed, must be entire up to the brain; *but when they are strongly felt,* their influence extends, or is reflected downwards, often to parts of the nervous system remote from those in which they originated. Each acts as a *stimulus*, or excites an involuntary instinctive impulse, which acts as a *stimulus*, on particular muscles only;—*and he cannot tell why.* Farther than this in the explanation of sympathetic actions, *I cannot go;* and I will venture to maintain, that whoever does go farther, goes on hypothesis, and will find himself opposed by facts.

"Most sensations, when occurring in an intense degree, appear manifestly, from their effects, to possess an influence which extends over a large portion of the nervous system. That such an influence, though extending widely over the body, should act as a *stimulus* only on one nerve, or set of nerves, seems hardly more surprising than the well known fact, that various impressions from without, although applied to different nerves, excite certain mental sensations by their action on individual nerves only."*

The views of the writer are not altogether unexceptionable. He describes most sensations as producing their several effects, from acting as a direct *stimulus*, on particular muscles. Sympathetic phenomena as frequently arise from the *withdrawal* of this stimulus as from its aroused operations. A painful impression at once allays the excited organism of the generative system, causes diarrhœa, the copious flow of urine, a profuse clammy perspiration, nausea, agitation of the limbs, the twitchings of muscles and various other effects. The sensation does not, in these cases, act as a *stimulus*, if by the term be understood the uninterrupted flow of the nervous energy, maintaining, as in agreeable emotions, its ordinary comprehensive and necessary relations to the brain; nor are the conditions to which it gives rise at all explicable on this supposition. Is this a distinction without a difference? Is it the same, whether the waters overflow the banks developing vegetable life wherever they extend; or whether they flow tardily and half stagnant within their narrow channel? Such is the difference in the state of the nerves in the two widely opposed classes of sensations. By the one they are excited to vigorous activity; by the other they are rendered languid and depressed. Each has its distinctive phenomena, and illustrates equally the modifications in the distribution of the nervous principle.

---

* Transactions of the Medico-Chirurgical Society. Edinburgh. Vol. II., pp. 223-4.

CCCIII. How much more striking are the manifestations of sympathy, when the mind is roused, whether by passion or the occasion which warms it into eloquence. We perceive then the brain in its wide relations to the entire body. The agent by which it is animated, gives to each nerve an energy in harmony with the awakened feelings. The eye and the whole countenance, the position and motions of the limbs, and the unrestrained torrent of words, portray the fervour which stirs from within. Are these marvellous changes in the outward expression, no evidence of a principle living along and vivifying each nerve? Mark the same individual, if suddenly prostrated by an unexpected calamity. Where is the fire that played in scintillations on the features, and breathed new life throughout the frame? The countenance has lost its fulness and vivacity; the body is at rest and indisposed to exertion; the respiration is slow and irregular in its successive acts; the heart palpitates or labours in the performance of its functions; the blood retires from the surface, and the production of animal heat is diminished. The whole animal economy instantaneously sympathises in the altered conditions of the brain. Can these results be referred to a *stimulus* carried in its accustomed current along the nerves?

How easy of explanation are these phenomena on the principles here developed, and how readily the application of them solves many of the supposed mysteries of sympathy. Even if it be an hypothesis to contend, that, in the one class of sensations, the nervous fluid flows in an invigorated stream from within, outwards; and in the other is arrested or retarded in its passage, if it serves to elucidate the effects, it has all the properties of a well adjusted theory. If we modify the course of the blood or sap, in any particular situation, the parts to which they are distributed, are proportionately influenced. The same reasoning applies to the doctrine which traces the agency of the nervous fluid. If the brain, in its aroused condition, is a cause which diffuses it throughout the animal economy, presenting unequivocal indications of its affluence; it is strictly philosophical to conclude, that the converse of this condition *will interrupt the transmission of the fluid not only to the extremities and surface of the body, but to the internal organs generally.* The depression cannot be partial. Every nerve, whether exercising the functions of animal or organic life, is involved in the disturbed cerebral action, and hence the derangement of all vital operations.

CCCIV. The potency of ideas, unexcited by immediate external circumstances, on the powers of life, is strikingly illustrated in the changes they induce in the organs of generation. In this relation they are interesting to study. They establish the justness of our views.

Every mental state is accompanied with a certain degree of cerebral activity. It is one of the causes which sets the nervous fluid in motion, and the extent of the external manifestations is invariably in strict accordance with its character. If a train of salacious ideas arise, whether in dreams or secluded retirement, the generative system feels the awakening influence.

The energy which is imparted to it reacts on the brain, and the two are reciprocally a stimulus to each other, and continue frequently in operation until the pressing necessities are relieved. If, however, when the whole mind is animated by the passion, and accompanied by the vigorous capabilities of the body, a thought is suggested unfavourable to the object responding to the imperious feeling, it is in vain to solicit nature. The will may remain, but the power is gone. And why has it departed? The nervous fluid which previously flowed in an abundant current between the brain and the remote organs, is arrested in its course.

These two instances are a remarkable illustration of the effects of sensation on the vital conditions of particular organs, and equally so of the correctness of the views on which they are explained. To attempt to construct a nervous theory, independently of a nervous agent, susceptible of these changes, would be an absurdity. The disposition which is occasionally shown, by enlightened inquirers, to stop, at what are designated ultimate facts, is detrimental to the progress of truth. The ultimate facts of one age are often the elements of mighty principles in the next. They are points from which the mind starts in advance to fresh ground. One of these facts, beyond which it is regarded as unphilosophical to proceed, is the co-existence of certain bodily states with sensation. We are not to investigate the mode in which this acts. To show that it is only one, of several causes, influencing the distribution of the nervous fluid, is, according to such reasoners, overstepping the legitimate rules of scientific research.

CCCV. No part of the animal economy so frequently presents sympathetic phenomena, unexcited by immediate external impressions, as the respiratory system. The study of it in its relations to the brain, confirms, in a remarkable manner, the theory which is here propounded. Whatever be the character of the nerves co-operating in the performance of the important functions of respiration; or whatever may be the regions whence they arise, they are simply the media for the conveyance of the nervous principle from their respective nervous centres. Hence whatever tends to disturb its current, will proportionately affect the successive acts of breathing. They indicate with considerable accuracy the nature of the passing thoughts. When these deeply interest the mind, whether agreeably or painfully, the respiration is momentarily arrested: sometimes it is short and quick, when the prevailing emotion is one of intense anxiety. Corresponding results are produced by dreams. Who has not watched the varying expressions of the infant in its slumbers, at one instant smiling, at another sad or grave, and the respiration equally affected by the transient feelings? The dog barking in his sleep, displays, in a striking point of view, the influence of ideas on the bodily organs. In this case it excites the respiratory apparatus to the comparatively vigorous exercise of its functions, independently of direct external impressions. Were we to study its manifestations in the aroused and wakeful states of the mind, modified by fitful emotions or concentrated passion, the accompanying changes in the character of the breathing would exhibit the intimate and comprehensive relations connecting the respiratory system of nerves with the brain. It is not necessary to enter into an elaborate consideration of the subject. The principles do not require any copious illustrations. They are few and easy to understand, and their application is equal to the explanation of the diversified phenomena which fall under observation.

Whatever may be the origin and distribution of nerves, they are distinguished by two properties only: they are either sensitive or motory; or in other words, either convey the nervous energy from within, outwards, to the seat of every vital operation; or receive and transmit impressions to the nervous centres. The same animating agent pervades both classes of them, and its disturbance is the occasion of all sympathetic affections.

CCCVI. The most remarkable illustrations of sympathy, arising from ideas unexcited by direct external impressions, are somnambulism, night-mare, crying and the distinct exclamations, or talking in profound sleep. A case of somnambulism once fell under our observation, and we had frequent opportunities of studying it. The person would leave his bed, and through intricate and dark passages would wind his way to a fire in the lower part of the house, before which he would stand without exhibiting the slightest consciousness. His eyes were wide open, but did not appear to display any sensibility to light. He was led back to his room without awaking, nor did he in the morning remember what had passed.

This case does not offer anything singularly striking, compared with numerous instances of the same kind on record. We perceive on these occasions the agency of thought in regulating the bodily movements, and, at times, with such exactness and propriety, in reference to particular objects, that the results clearly imply considerable mental activity, exercised, however, without the ordinary controlling influence of consciousness. The individual is absorbed by a lively and predominant train of ideas, and, in passive obedience to it, a variety of muscular actions are performed. The two do not always harmoniously co-operate. The strong desire to move the limbs is not invariably accompanied with the power. The mind may be greatly excited, as it is in night-mare or incubus, to escape an apprehended calamity: it may struggle to arouse all its energies, but the effort is unavailing. Hence it is reasonable to infer, independently of all views on the diversity of the mental faculties, that thought occupies one region of the cerebral mass, and the source of muscular motion another,—a conclusion which appears to be established by direct experiments and the phenomena of disease.

CCCVII. In allusion to this subject, a well known writer observes: "It must be confessed, that there is something obscure, both in the cause producing incubus, and in the relative condition of the physical and mental powers. It would seem as if the mind and body were in different, or even contrary states, *the body in the most profound repose,* and the mind peculiarly active, and this disproportion existing in such a degree as to constitute something approaching to disease."*

The body is in that state of rest which is natural to it, and it is as susceptible of being influenced, as at any other time, did the necessary *cerebral* condition exist. The cause of the phenomenon is to be sought in the brain, and an explanation, at least, plausible, may be found in the disturbed distribution of the nervous fluid. The regions of thought and of the source of muscular motion, are connected by intermediate structure, which is the medium for the transmission of volition, and can be effected only through the agency of the nervous principle. Two suppositions present themselves to account for the inadequacy of the *will* to produce its usual effects. That portion of the cerebral mass, through which it operates in giving rise to muscular motion, *is either not in a state to be excited by the stimulus conveyed to it, or the structure which connects it with the seat of thought, does not transmit it.* The latter conjecture is the most probable, and from this consideration: the medulla oblongata, is evidently in a condition to supply the required stimulus to its respective nerves, as is shown by the continued activity of the respiratory, which are implanted in it, whose functions are both voluntary and involuntary.

---

* Bostock Opus cit., p. 814.

It will scarcely be argued that in incubus the mind is not exceedingly active. Thought follows thought in quick succession, and in such vivacity that extraordinary efforts are made to escape a distinctly pictured danger. The will, however, is inoperative. The limbs will not obey the feeling.

CCCVIII. The exciting causes of night-mare may generally be traced to derangement of the stomach, arising from its undue repletion, or the indigestibility of the food, and either will produce a state of the nerves of the stomach, in relation to the brain, which is unfavourable to the exercise of the entire functions of the latter. A larger amount of nervous energy is concentrated in the stomach than is compatible with sound repose. This is, indeed, broken through the agency of the digestive apparatus, exciting a lively train of ideas, but so disturbing the natural conditions of other parts of the brain, that they are incapable of communicating their influence to the nerves governing the voluntary muscles, and hence the phenomena of incubus.

CCCIX. Voluntary motions are frequently, in disease, converted into involuntary, and are rather aggravated than controlled by the determined exertions of the will. The inability of the aroused thoughts to regulate the movements, shows that the power by which they are influenced, occupies a region distinct from that which is the seat of ideas,—a region according to this view possessing its own independent stimulus. Numerous facts might be adduced in illustration of this conjecture, but the analysis of them would lead us away from the immediate objects of this inquiry.

CCCX. There are few subjects of greater interest, or which bear more directly on the speculations of philosophers concerning the mental faculties, than incubus and somnambulism, which agree in one respect, in the activity of the mind, but present extraordinary differences in the influence which it is capable of exerting on the body, as well as in the marvellous acuteness of the sense of sight, which occasionally characterizes the latter state of the brain. Minute objects are not only discerned, in what to us is absolute darkness, with precision, but elaborate operations are performed with a nicety and correctness equal to, if not, at times, surpassing the studied efforts of the waking hours.

No suggestions have been offered to account for this phenomenon. It cannot be ascribed to the action of light on the retina, for, in the first place, there is no evidence that this is sensible to it; and in the next, the agent is not present to stimulate it. We have, therefore, a peculiar state of the *internal* organ of vision, executing its ordinary functions, without the co-operation of the external apparatus with which it is regularly associated. This cerebral condition has not yet been studied in a truly philosophical spirit; nor has advantage been taken of the light which the contemplation of it elicits, in reference to a wide class of mental phenomena, to which it has an intimate relation. It would appear, as if nature occasionally displayed these extraordinary manifestations, to awaken not only a peculiar interest in her works, but to furnish the key by which many of their seeming mysteries may be solved. We are slow in appreciating the value of the hints she throws out, and especially if the carrying of them out is likely to lend support to doctrines, which we have been taught to regard as either absurd or untenable. It is admitted that the somnambulist *can see clearly in the dark*, and as the eye is insensible to external impressions, without its usual co-operation; but a similar fact in somnambulism, asserted to be produced by mesmeric agency, is ridiculed in no measured terms. Do not the two cases in any degree approximate? Is there not a relation between them sufficiently obvious, at least, to disarm prejudice and stimulate inquiry? How does nature operate without her usually complicated instruments? Is not the answer to be found in the existence of an *abnormal* cerebral condition? Can art in any possible way induce it? If it can, why should not corresponding results follow? Investigation will alone determine the question.

CCCXI. Among other sympathetic effects, is yawning, which has not been particularly investigated by physiologists. An acute writer thus explains it: "As connected also with the action of the proper respiratory muscles may be mentioned the effect of such an *irritation* of the diaphragm as produces its convulsive descent upon the muscles which depress the lower jaw, the jaw descending jot for jot with the diaphragm, so as to occasion yawning."*

CCCXII. This occurs generally in the evening, in persons fatigued with the labours of the day, or drowsy from late hours and other causes; and is, also, frequently observed in the morning, before the mental faculties are thoroughly awakened. It is characterized by a slow and deep inspiration, and followed by an expiration equally full and protracted. It is evidence of an inactive state of the brain. There are two views on which the phenomenon may be attempted to be explained: that it is indicative, as a general rule, of a modified cerebral condition, approximating to that which distinguishes sleep, will not be questioned. The consideration of the circumstances which promote it, as mental and bodily exertions, and, as is well known, a substantial repast, establishes the fact, that the diminution of or change in the distribution of the nervous energy, is an antecedent to the effect which falls under observation. This state of the cerebrum may be regarded as interrupting the ordinary relations between it and the respiratory organs, particularly the draphragm, so that the descent of this from relaxation, or want of nervous power, may give rise to the rushing in of the air, occasioning the deep inspiration and the fall of the jaw. Or that portion of the brain in which the respiratory nerves are implanted, not being sufficiently stimulated to perform with efficiency and regularity its important functions, the nervous principle may, at intervals, accumulate, until at length it excites a much greater number of nerves than are usually called into play by respiration, and hence the phenomenon of yawning. After a successive series of such acts, especially in the morning, when the mental faculties are awakening to fresh life, these manifestations of cerebral derangement cease. In the evening they terminate in sound sleep, from the gradual decline in the activity or demands of the same faculties. In the one case, the brain, from the excitation of the senses, enters upon its wide range of duties, the exercise of which necessarily diffuses new energy throughout the animal system: in the other, the shutting up of these senses, as the media of a variety of stimuli, enables the organ by imperceptible degrees to resume those conditions essential to the restoration of the exhausted powers of the animal economy.

---

* Fletcher Opus cit. Part II. *b.*, p. 3.

Yawning is readily induced by observing the act in others. This is an exceedingly curious and interesting phenomenon, and is alone explicable on the supposition of an impression, of which we are altogether unconscious, modifying the action of the nervous fluid. For a moment the ordinary state of the brain is disturbed, and the effect which follows is evidence of it. The symptom has certainly a tendency to allay the activity of the mind, and it will seldom produce it in others, unless the prevailing feelings, or rather the existing mental indifference, strongly predisposes to it It is well known that whatever rouses the mind, when the manifestation of it seems irresistible, immediately corrects it. And why? Simply because the excited feelings set in lively motion the nervous principle, and thereby furnish the required stimulus to the respiratory system of nerves.

CCCXIII. The previous views are borne out by the analysis of every circumstance connected with yawning. Whether we take into account the age, temperaments, habits, or the influence of severe or long continued labour, the same reasoning justly applies. How common it is in young children when disposed to sleep. What is sleep but a cessation of the active powers of the mind, and consequently every approximation towards it, is gradually inducing those cerebral conditions which give rise to the phenomenon. It occurs particularly in those who are constitutionally heavy, phlegmatic, prone to sensual indulgences, and by no means of an energetic or intellectual character. How easily this class of persons can usually lay aside the cares of the world in profound slumber; and how often in such we remark the premonitory symptom under consideration. It is scarcely necessary to allude to the effects of mental or bodily exertions, as sources of nervous exhaustion. This will be admitted. The inevitable tendency of them,—if not carried to an extreme point, is to allay the wakefulness of the mental faculties, and hence the readiness with which sleep, and its frequent antecedent—yawning, take place.

CCCXIV. These views are further confirmed by the phenomena of disease. In most fevers, especially in those of a typhoid character, repeated yawning is a common precursor. It is evidence of cerebral depression. All the symptoms unequivocally indicate it. We perceive the indisposition to bodily and mental exertion; a diminution of sensibility; a tendency to doze; the absence of the ordinary animated expression of the features, and the general prostration of the vital powers. The normal relations between the respiratory nerves and the brain are disturbed. The phenomenon occurs in the *transition* state of this organ to sleep or wakefulness. If one may be permitted to use the expression, to illustrate our meaning, it arises from the struggle between two different portions of the cerebral mass,—*the one the seat of the mental powers—the other in immediate connexion with the nerves maintaining the required relations with the system at large.* Sleep is the termination of the struggle, and the adjustment displays the exquisite wisdom pervading the works of nature. The nervous principle, which during the waking hours, is in vigorous play, from the activity of the senses and the pursuits and occupations of life, is at length under the necessity of conforming to a new state of things: rest is essential to the restoration of the enfeebled or exhausted energies, and this is effected by *economizing* the expenditure of the nervous fluid. This, on the occurrence of sleep, is drawn within a narrower sphere of operations, and hence is enabled to respond, with regularity and force, to the demands of the mixed functions of organic and animal life.

CCCXV. These views are susceptible of still further application. They will explain on philosophical principles a variety of phenomena, which have not been elaborately studied by the physiologist. The consideration of them will throw light on the source of a variety of sympathetic actions. Why are children and persons of gross sensual appetite, who live rather to eat, than eat to live, peculiarly prone to sleep? and why is this facilitated in a striking manner by a substantial meal at night? These important questions have not hitherto received the attention they deserve. On the doctrines here laid down, they readily admit of solution. The nervous principle cannot, except in rare and extraordinary instances, minister to the imperious demands of two different portions of the nervous system. Man cannot exercise with clearness, ease and vigour, his intellectual faculties, and at the same time fully satisfy the urgent wants of a sound appetite. Nature will not concentrate her energies in two opposite directions. The powers of animal and organic life are antagonists. The child and the sensualist approximate in their conditions. The activity of the digestive organs predominates in both. In the one, it is natural and required for the development of the system: in the other, it becomes unnatural from vicious or ill regulated tastes. Results somewhat similar are observed in both. The child gradually passes through its transition stages of being, from the accretion of new matter: the sensualist frequently exhibits an unwieldy and useless mass of flesh, and the countenance generally indicates the revolting fact, *that the body is living at the expense of the higher faculties of the mind.*

The moment the functions of the stomach are excited, or the organ is in a state of repletion, the nervous fluid that was previously in action, in connexion with the senses and the intellectual powers, flows in the direction of the digestive apparatus, *leaving necessarily a less amount to maintain these powers in vigorous play,* and hence the ease with which they are lulled into the forgetfulness of sound repose. The water-wheel stops, or feebly moves, on the withdrawal of its accustomed supply. The superior attributes of the understanding can act only when furnished with the needful stimulus. To controul the course of the nervous fluid, is to modify the character of vital operations whether they belong to animal or organic life. Sleep and all its accompanying phenomena, are a forcible illustration of the truth of these views. It is not, however, our intention to enter here into an elaborate description of them. We propose, on some future occasion, to study them in all the variety of their relations to the animal system.

CCCXVI. Another symptom sometimes connected with sleep, demanding a few remarks, is the phenomenon of *snoring*,—a fact richly worthy of examination. It occurs in those whose sleep is the most *profound*, and generally in those in whom the animal largely predominates. It is fraught with high interest to the physiologist, and unless we are greatly mistaken, the explanation of it, will strengthen materially the doctrines laid down. *The cause is to be traced to that portion of the brain whence the respiratory nerves originate.* These are greatly excited, as is shown by the strong successive acts of inspiration and expiration, the unseemly opening and closing of the jaws, and the simultaneous movement of the whole muscles of the face, without the slightest indication of intelligence. In no condition of the animal economy is there such an entire absence of the manifestation of mind in the features, as is exhibited by snoring. Does not this symptom demonstrate the most complete repose of the mental faculties? They are certainly not lighted up by any transient thought: nor has this left behind it, impressed upon the countenance, the last shadowy traces of its activity. We have simply an animal that breathes. What is the inference which naturally flows from these facts? If the nervous principle be essential to every mental operation, and regulated in its distribution according to the energy by which they are distinguished, does it not follow, that the more perfect the cessation of them, *the* *greater will be the amount set at liberty to minister to other functions?* Is it possible to avoid this conclusion? And if it be freed from one class of engagements, it must inevitably enter into others. It flows to and accumulates in the region whence the respiratory nerves arise, and the additional stimulus which it imparts, excites these nerves, and hence the phenomenon of snoring. In what other mode is it possible to explain it? It is always the result of the same cause, modified in degree according to the changes in the distribution of the nervous agent.

CCCXVII. There are other considerations which corroborate these views. Snoring is the frequent accompaniment of that deep sleep, or rather stupor, consequent on inebriation. It will scarcely be denied that, under such circumstances, the great nervous centres will be unduly stimulated, and the symptom in question is evidence of the fact. Its occurrence, also, in other cases of insensibility, admits of easy explanation. Whatever tends to diminish the activity of the mental faculties, predisposes to the manifestation of the phenomenon. From the light which these principles throw upon the operations of the animal economy, we get a comprehensive view of the source and nature of sympathetic affections. Whatever be their character, or in whatever region they present themselves, THEY INVARIABLY ARISE FROM CHANGES IN THE DISTRIBUTION OF THE NERVOUS FLUID.

CCCXVIII. The phenomenon of sighing has been studied with attention by physiologists, and the explanation which Darwin first suggested, is regarded as correct. From the attention being occupied by a train of ideas, or emotion, of intense interest, "we for a time forget to breathe; at least, the *sensation* which we here suppose to be the natural stimulus to the act of inspiration, being comparatively unheeded, and little *felt,* the action is performed less frequently, and less perfectly than usual. In consequence, a degree of *stagnation* of blood in the lungs takes place; and, then, on the first interruption of the engrossing train of thought, the sensation resulting from the presence of venous blood in the lungs is *felt in unusual force,* and an unusually full inspiration naturally follows."* The individual is rarely conscious of any *sensation* leading to this full inspiration, and in fact he is only occasionally sensible of the act of sighing. To refer this particular effect to a sensation not felt is scarcely philosophical. Nor does the hypothesis appear to be a just interpretation of the phenomenon. It leaves out of consideration some of the most interesting circumstances associated with it. The attention is directed to the induced condition of the lungs as the cause of the change. The constant play between the brain and the respiratory organs, is due to the structural relations between the two, *maintained by a definite class of nerves;* and this action continues not only in the wakeful state of the mind, but in profound sleep and the most complete coma. Sensations in the last named case, can scarcely be regarded as the cause of *inspiration*. To insist on this would be an abuse of language. The flow of the nervous fluid, on this occasion, from the brain along the respiratory system of nerves, no more depends on sensation than does its transmission to the stomach, heart, or intestines, by which these organs are enabled to contract and exercise their several functions.

---

* Professor Alison. Trans. of the Medico-Chirurgical Society of Edinburgh, Vol. II., p. 179.

The absorbing train of thought clearly arrests the inspiration. This can be effected in one way only. It prevents the flow of the nervous principle to the nerves in question. Did *they* receive it, as usual, they would act. The cessation of their operation is evidence that the existing ideas modify its ordinary course. This, however, is as likely to accumulate, during the momentary suspense, in the *region* whence the nerves arise, as that the blood shall stagnate in the lungs. And the change occurring in the former, is probably largely instrumental in the production of the inspiration.

According to the writer, the interruption to the engrossing train of thought, is the *measure* of the frequency of sighing. The intensity of the emotion, on extraordinary occasions, is not limited to a few seconds of time. The *necessity* for the deep inspiration, is the cause, and not the sensation, awaiting to introduce itself in the break of the predominant ideas. If there be a sensation, which is felt, this is not the cause of the prolonged inspiration, but an *effect* of those conditions which necessitate the act of breathing.

CCCXIX. Admitting that the deep inspiration is to be traced to some peculiar state of the respiratory organs, it is by no means satisfactorily proved, that the cause is the accumulation of venous blood in the pulmonary vessels; nor is it the only important circumstance demanding particular examination in connexion with the phenomenon: there is, indeed, another which has been entirely overlooked by the physiologist, *viz.*, *the condition of the air within the lungs.* The attention has been confined to the blood, as if it were the only agent in any degree susceptible of modification, and hence calculated to influence the character of the respiration. If we adopt the prevailing opinion, that the oxygen and nitrogen inspired, are absorbed by the blood with which they are in contact, it is evident, that during the suspended breathing, they are rapidly disappearing, and the rushing in of the air does not *follow* as an effect from any clearly ascertained mental impression, but is simultaneous with the first step in the process of inspiration, to fill the void, if not created by the absorbed air, by the gradually expanding thorax. And if a cause is to be sought to explain its successive acts, in an uneasy sensation induced, the necessity for fresh air is far more probable than the imagined pulmonary congestion.

This doctrine takes it for granted, that the blood can flow only into the lungs during inspiration, and so painful is the sensation arising from the interruption of the latter, for a few seconds, that the individual is forced to breathe to allow the fluid to pursue its course, and this in fact is the sole cause of the inspiration.

CCCXX. Is it not singular that the changes in the properties and bulk of the air, occurring at every instant of time, which are of the highest vital importance to the system, should have been entirely passed over in the attempt to account for the phenomenon? There is no assumption in contending for the existence of these changes; there is, however, in arguing for the accumulation of the blood, and the implied *necessity* of inspiration to permit it to flow forward.

An elaborate investigation of the function of respiration would present serious objections to this conclusion. The contractions of the heart and the acts of inspiration, are not so intimately associated as that the one is to be regarded as the effect of the other. The right ventricle, which propels the blood into the lungs, contracts, on an average, four times to one inspiration; therefore, this is clearly not in relation to the successive quantities transmitted. Had the inspirations been equally frequent, the foregoing conclusion would have had much greater force.

CCCXXI. There is another consideration of some weight deserving attention. The doctrine here combated lays it down, that the suspended breathing, for a few seconds, gives rise to an accumulation of blood in the pulmonary vessels, in consequence of which a painful sensation arises and excites the deep inspiration. If, during this brief period, such an accumulation takes place, and such a mental impression inevitably follows, what would be the condition of the lungs and the acuteness of the suffering, in the case of pearl-divers, who are capable of remaining under water from one minute to a minute and a half? During this time the right side of the heart has transmitted to the lungs, at a moderate calculation, an amount of blood nearly equal to one-fourth possessed by the entire body. If inspiration be directly essential to pulmonary circulation, and if the congestion resulting from its temporary interruption, causes a painful sensation, death would invariably follow on all such occasions. Inspiration does not stand in this exact relation to the motion of the blood, *but to the conditions of the air.*

CCCXXII. The respiration is frequent or otherwise according to the capacity of the lungs. Where this is great, it is usually slow; where it is much diminished by disease, it is always quick and short. In aggravated cases of pulmonary congestion, in which the lungs generally are hepatized, or are so changed in structure, as to have lost altogether their resiliency, the successive acts of breathing, in a given time, are nearly trebled. The efficiency of inspiration, in promoting pulmonary circulation, must depend entirely on the elasticity of the lungs. It must in fact be in the ratio of it, if it exert any influence at all. In numerous instances of disease, it is destroyed, and, therefore, what becomes of its agency, as a moving power of the blood, or as essential to its circulation in the lungs?

The diminution in the capacity of these organs for air, may be measured with considerable accuracy by the *increase* in the number of inspirations. In the cases to which we have alluded, the breathing is exceedingly frequent, not arising from the small quantity of blood in the lungs, *but the small quantity of air*, and hence the necessity for its repeated renewal, and the intimate relation between it and the character of the respiration.

CCCXXIII. In investigating, however, the influence of the temporary accumulation of blood, or that of the air, as indirect causes of inspiration, we lose sight altogether of the state of the nerves. They might be mere inert cords connecting the brain and the respiratory organs. If they are animated by an agent diffusing energy to all parts of the system, is it to be imagined that during the interrupted breathing, followed by sighing, that they are unaltered in their condition, in fact that they cannot act until an impulse has been conveyed from their peripheral extremities to the cerebrum? It is more than probable that their suspended activity gives rise to such changes, or such a modification of function, at their cerebral extremities, as may be influential in producing the deep inspiration.

This opinion seems to derive support from phenomena which we have studied with some interest. The heart taken from a living animal continues to contract regularly for some time, but at length the contractions become not only feeble, but take place at unequal periods. After a considerable pause it will act again. During the interval, it would appear that the exhausted nerves acquire a sufficient amount of nervous energy to resuscitate the muscular motion. The same thing is strikingly observed in the fragments of muscles in the decapitated head of the calf recently killed. If a pause in the action of nerves in one case, so modifies their condition, as either to revive or strengthen such action, is it unreasonable to suppose, that a corresponding change may be induced in the respiratory system of nerves, during the temporary suspended breathing? The evidence in favour of this conjecture, is quite as strong as that which endeavours to trace the result to the *stagnation* of blood in the lungs. A variety of interesting facts tend strongly to substantiate this view, showing that whatever directly influences the condition of that portion of the brain, in which these nerves are implanted, proportionably affects the respiration. The dashing of cold water on the face, in fainting, is immediately followed by a full inspiration. The superficially seated nerves are excited, and the stimulus they receive is at once communicated to their cerebral connexions, and hence the result. Irritants applied to the nose, and, in some persons, light falling vividly on the eye, cause sneezing. A modification of the nervous principle, at the origin or insertion of these nerves, during the interrupted breathing, may, also, to some extent be instrumental to the deep inspiration designated sighing. All nerves must be regarded as having two extremities: the one connected with a nervous centre: the other distinguished by its peripheral relations, and hence nervous phenomena are produced in two different modes. Every process, whether it be secretion, absorption, assimilation, or the contractility of organs, as manifested by the stomach, the intestines or the heart, is an operation, accomplished at the expense of the nervous principle, *causing it to flow towards the seat of the vital action*, without exciting any sensations. Respiration is effected in the same manner. When some of the organs, in which these changes occur, are so far disordered as to occasion pain, the nerves then form new relations with their respective nervous centres, and give rise to a variety of sympathetic phenomena, which we leave for subsequent consideration.

Emotions, or thoughts, are mental states which affect the condition of the nervous principle, at the *cerebral* extremity of the nerves. They controul its course, consequently its agency, on every fibre of the animal system. Sighing is an illustration of the influence thus exercised. The absorbing train of ideas arrests the respiration, by interrupting the transmission of the nervous fluid.

CCCXXIV. "Every one," observes Professor Alison, "must have observed the coughing and sneezing which, in a crowded assembly, on a winter day, infallibly succeed the profound silence occasioned by a speech of uncommon brilliancy and interest; and which imply, that the causes of the sensations preceding these actions had existed for some time in many of the audience, but the sensations having been overpowered by other and more predominant feelings, their natural consequences had been suspended, until these feelings had in some measure subsided, and allowed the irritations in the air-passages to become objects of attention to the mind."* This is justly and beautifully described. These phenomena are easily explicable on the principles here developed. We have already admitted that thought and emotions are among the several causes which modify the distribution of the nervous fluid, and excite sympathetic action. The important question is in what manner. All are familiar with the fact. Thought and feeling cannot exist apart from the co-operation of this fluid, no more than secretion can take place without the presence of the blood; therefore, every state of the mind is a faithful representation of the condition of this agent, in relation not only to the mental faculties, but to the whole animal system. When a person is deeply absorbed, listening to an eloquent discourse, the whole frame exhibits the effect. Its position and the expression of the features, show the profound interest excited. The predominating ideas are a measure of the nervous principle in operation in one

---

* Medico-Chirurg. Trans. supra cit., p. 180.

particular direction, and they employ the largest possible amount. The cessation of their intensity, liberates a portion of it, which immediately *re-establishes its normal relations with the cerebral nerves,* and hence the phenomena resulting from the exercise of their functions,—the awakened sensibility of the brain to internal irritations.

These views will elucidate other sympathetic phenomena of considerable interest, and the explanation of them will strengthen many of the preceding remarks.

CCCXXV. The protracted continuance of respiration in extreme cases of coma, is a subject worthy of consideration. Professor Alison remarks, in allusion to it, "the sympathetic action which, in the state of coma, exists the longest, is that which is most essential to life, respiration; but it ultimately undergoes a change, corresponding to the gradual diminution of the *sensation,* which we have considered as its cause, —becoming slower and less perfect; and when it *ceases, in the case of death* simply by coma, *no sign of sensibility survives it,* but the power of muscular irritability remains for some time."*

The writer here says, that when respiration ceases, in the case of *death* simply by coma, no *sensibility* survives it. Is this ever observed after death? The term implies here the existence of consciousness. In extreme instances of this kind, sensation is not a stimulus to respiration, nor is it essential to its continuance. This is secured by laws of vital action, which have not been fully apprehended by the physiologist; and the thorough understanding of them will show, that sensation is not required to account for the phenomenon. We have, in a previous portion of this treatise, attempted to prove, that the successive contractions of the heart, are not to be ascribed to the direct stimulus of the blood, but to the influence of the nervous energy. The amount which is lost by each contraction, being supplied during the interval of the succeeding dilatation, its functions are regularly maintained. Sensation performs no part in this process. The same view applies with equal force to the phenomena of breathing. The respiratory organs, though partly under the influence of volition, have precisely the same general relations to their respective system of nerves, and the laws by which they are governed, whether they draw the nervous principle from the medulla oblongata, the spinal marrow, or from any other source, are not in any degree affected by the circumstance.

---

* Trans. supra cit., p. 176.

Inspiration and expiration may with perfect accuracy be compared to the successive actions of the heart, and they will controul, in the same manner, the flow of the nervous fluid. The inspiration necessarily brings into play the nervous energy, and operates as a *direct* stimulus to that portion of the brain whence the respiratory nerves arise. And thus, long after the disappearance of all consciousness, and when sensation cannot possibly be considered as a cause of respiration, this continues, *as the natural result of those laws which regulate all functions characterized by intermittent action.* Hence the sympathetic effects, in all such cases, are not to be traced to the persistence of any *sensation*, but to other causes which influence the motion of the animating agent of the nervous system.

The respiration certainly becomes slower and less perfect as the aggravated symptoms of coma increase, but this does not prove that it is due to a corresponding change in the strength of the sensations. They do not stand to each other in the relation of cause and effect. When the mind betrays no evidence of the slightest remains of consciousness, the breathing continues to be performed with considerable fulness and force, and ceases only when the properties of the blood are unequal to the maintenance of the functions of life. If sensation be the cause of its activity, it ought, at least, obviously to decline, which it does not, from the first manifestation of blunted sensibility.

The successive acts of breathing no more depend on the momentary accumulation of blood in the lungs, exciting an uneasy sensation, than the contractions of the heart depend on the presence of the blood as their immediate stimulus. Not only in these, but in all cases of intermittent action, the cause is to be traced *to a modification in the condition of the nerves brought into play.*

CCCXXVI. The remarkable sympathy between the surface of the body and the brain, is displayed in blushing. This will sometimes occur when the person is altogether removed from observation. The suggested ideas instantaneously crimson the countenance. The phenomenon is to be ascribed to a *direct* influence conveyed to the arterial capillaries, by which the blood is either arrested in its course, or increased in its flow towards them. The former effect would necessarily produce the latter. Physiological considerations would certainly lead one to infer, that an additional quantity is, with the rapidity of thought, urged into the vessels. They are richly endowed with nerves, and evidently for the purpose of enabling them to controul and regulate the course of the blood. That this is modified in its circulation, when in no degree affected by the contractions of the heart, is a fact requiring no elucidation. The *cause* of the activity of the vessels, under these or any other circumstances, may give rise to a difference of opinion. When we perceive, however, the extraordinary changes in the conditions of organs, arising from emotions, it is impossible not to regard the nervous system as directly instrumental in the production of them, from stimulating or depressing the capillaries which are concerned in all vital actions.

CCCXXVII. Another explanation of blushing has lately been offered by a writer, whose opinions always demand a respectful consideration. He observes: "I may now repeat that the phenomenon of blushing is familiar to every one. Obviously the effect of emotion, I have suggested the *contraction* of the platysma myoides on the *external* jugular vein as the *second* link of the chain of causes and effects, and the impeded return of blood along this latter, as the *third*."*

This hypothesis has certainly little to recommend it. The alleged cause is inadequate to the production of the phenomenon. Were this confined to the face or the immediate regions of it, the imagined change in the condition of the *external* jugular, might then be regarded as worthy of consideration, but clearly not otherwise. In persons exceedingly fair and peculiarly sensitive, it is not unusual to observe the whole of the neck, both anteriorly and posteriorly, the arms, as well as the entire bust, suffused with crimson. It is utterly impossible for any slight compression of this vein to occasion so remarkable a manifestation on so large a surface of the body. It is giving it an influence which it is quite incapable of exercising. To be worthy of attention, the cause should be shown to be equal to the effect, not in one particular cutaneous region, but wherever the delicacy of the skin displays it.

The writer will scarcely contend that this extensive agency can be ascribed to the *external* jugular. It does not receive the blood from the regions to which we have alluded; and it is equally clear, that any compression of it can only affect parts *above* it; even if the vessels of those *below* it, were to pour their contents into the same vein, which they do not, the obstacle to the venous current, in that precise situation, would in no degree be felt by them. Blushing is not, however, limited to the regions specified: it occasionally affects the entire surface of the body.

---

* Dr. Marshall Hall, Lancet, No. XI., p. 286. 1849.

CCCXXVIII. There is another consideration which is by no means favourable to his speculations, and though less decisive in its character, cannot be passed over. The blood in the arterial capillaries is supposed to be arrested by the contraction of the platysma myoides, on the external jugular,—arrested from not being able to flow forward to the minute veins which ultimately terminate in that vessel. Now this imagined temporary obstacle, which must be exceedingly slight in degree, has to affect the whole of the capillaries intermediate between itself and the attenuated arteries, distributed to the face, before the phenomenon of blushing could occur. We contend that this is excited in less time than the partial disturbance of the venous stream could influence the superficial capillaries. It is certainly impossible to furnish evidence of this, but it may be shown to be well founded, in considering the rate at which the blood moves both in the larger and smaller vessels. The expression of the emotion is instantaneous. It is as quick as thought, and is manifested, at the same instant, on all parts of the body which fall under observation.

CCCXXIX. This opinion of the writer is to be traced to his peculiar notions on the moving powers of the blood. He does not allow the capillaries to be one of these agents. We have elsewhere* attempted to show, that the experiments he performed in illustration of his views, were not conceived in a philosophical spirit, and were destitute of those conditions essential to accurate results. Therefore, not regarding the capillaries as capable of influencing the current within them, he adduces the supposed contraction of a muscle, on a particular vein, to account for the interesting phenomenon of blushing.

We conceive there is only one mode of explaining its occurrence, and that is the direct influence of the emotion on the superficial capillaries; or in other words, a peculiar state of the brain is induced, which affects the vital properties of these vessels, and hence the increased flow of the blood within them. This, and other immediate changes in the functions of the skin, consequent on mental affections, appear to us to exhibit, in an exquisite manner, the innumerable links of vital action in indissoluble union with the great nervous centre, a modification of which, at once, disturbs the finely adjusted balance which holds the whole in harmonious relation. The phenomena resulting from the disturbance are the sympathies which it is our object to study.

CCCXXX. If we imagine, in case of exciting emotions, that the nervous principle is transmitted to the superficial arteries, in augmented quantity; and further, that the quantity which they always possess, is the

---

* The Philosophy of the Moving powers of the Blood.

stimulus by which they are enabled to perform their vital offices; it is clear that every change in the amount of this stimulus, will be accompanied with an alteration in their functions, frequently evident to observation, as in blushing. Guided by these considerations, another phenomenon of the cutaneous surface, arising from emotions, is easily explicable, *viz.*, sudden pallor. If the excitement of the brain, under particular circumstances, *accelerates* the flow of the nervous fluid, a depressing sensation will arrest its course, and hence an effect is produced, which may be designated the collapse or paralysis of the capillaries, which will interrupt the flow of the blood, on the circulation of which the complexion exclusively depends. If the sensation be exceedingly severe in its character, an abundant and clammy perspiration is the result. The same reasoning not only applies to this aggravated condition of the skin, but is, in our opinion, materially strengthened by it. What causes the watery portions of the blood to ooze out thus freely? If we take into account, that the same mental impression frequently occasions diarrhœa, and the copious emission of pale urine; and, also, a variety of other symptoms, such as the small, hesitating pulse, the struggling contractions of the heart, the cold extremities, and the agitation of the limbs, there is only one conclusion at which we can arrive, *viz.*, the circumscribed distribution of the nervous principle to the superficial capillaries, as well as throughout the animal system. Neither on the surface of the body nor internally, have they the power of retaining their contents. These phenomena display, in a striking manner, the origin and nature of sympathetic effects.

CCCXXXI. In connexion with this branch of the inquiry, the whole of the digestive apparatus presents a wide field of sympathetic phenomena, in illustration of the justness of these views. We shall, however, simply allude to the principles on which they are explicable, without entering into detail to exhibit their comprehensive application. We have endeavoured to show, that every mental state co-exists with a certain condition of the nervous fluid, and that this is accelerated or retarded in its flow to all parts of the body, according to the character of the predominating feelings. The changes in its distribution are the foundation of all sympathetic action, and the occurrence of this in organs, remote from the exciting cause, can be explained only on this doctrine. To establish the justness of it, it is not necessary to prove that the nerves by which it is manifested, have a direct connexion with the brain. All nerves, whatever be their functions or situation, have such a relation to it, as to be susceptible of the influence of every cerebral condition.

CCCXXXII. The appetite is sharpened and the digestion facilitated by agreeable ideas. When they are the characteristic of the temperament, their effects are observed in the healthy expression of the countenance, in the clearness of the skin, in the alacrity of the movements, and in the ease and freedom with which the ordinary duties of life are performed. They stimulate all secretory organs. When it is considered that they as accurately represent the excited nervous state of the brain, as the full and bounding pulse does the force of the contractions of the heart, it is evident that the nervous principle is flowing in a liberal current to all parts of the body,—that these in fact are placed in harmonious relation with the nervous centres whence they draw the stimulus of life. If such ideas are abruptly disturbed, and succeeded by others of a depressing character, a new and extraordinary class of sympathetic phenomena at once present themselves. The desire for food is feebly, if at all felt, and if taken will often produce nausea. The nervous agent being no longer transmitted in its usual amount to the stomach, the gastric juice is deficient in quantity and vitiated in its properties, and hence the food continues to irritate the sensitive nerves of the organ, until it has established fresh relations with the brain, one of the frequent consequences of which is,—the phenomenon of vomiting.

CCCXXXIII. Painful emotions, less severe in degree, exercise a corresponding influence on the whole of the digestive apparatus. But whatever be its character, it is explicable on the same principles. Whether occasional nausea, diarrhœa or pain, be its manifestation; or indeed the gradual deterioration of the powers of life, as displayed in the loss of strength, the wasting of the flesh and the inability of mental exertion, the effects are to be referred to the same general cause—*a modification in the distribution of the nervous energy.* The nervous system is not alone disordered, *but it is the first link in the chain of causation,* influencing the quantity, quality, and motion of the blood, which, also, becomes a source of morbid action, extending and aggravating the impressions conveyed from the brain to the nerves.

CCCXXXIV. The further analysis of night-mare has suggested a few additional remarks. It may possibly be urged against the speculations offered, that this peculiar state of the brain may be the consequence of undue pressure on certain blood vessels, thereby disturbing the cerebral circulation. Admitting this hypothesis, which does not materially militate against the general scope of our views, we have still to explain the inability of volition to produce its usual effects. Incubus may arise from very *different* circumstances, but whatever be the nature of these, the cerebral condition which results, and on which the interrupted action of the will depends, remains to be accounted for.

CCCXXXV. In the phenomena of night-mare, we observe a striking difference between the potency of the will and emotions,—a difference which is fraught with high physiological interest. While the former appears to be paralyzed, or, at least, if exerted, inoperative, the latter are capable of affecting strongly the limbs. When the feeling of the apprehended danger becomes intense, the lower extremities are sometimes excited, and the irregular and agitated movements mostly end in breaking the disturbed sleep. These effects, flowing from the agency of the emotions, strengthen a previous remark, that the constrained or interrupted power of the will, does not originate in a disordered condition of that part of the brain whence the voluntary nerves arise. These are roused into considerable action by the emotions, and, perhaps, to as great an extent as is possible, from the influence of feeling undirected by volition.

CCCXXXVI. The phenomena, also, show that the will and the emotions occupy different cerebral regions, and that the peculiar state of the brain co-existing with the latter, usually terminates in imperfect wakefulness. The mode in which this is accomplished, is not difficult of explanation according to the views here laid down. The liveliness of the emotions is a measure of the amount of the nervous energy called into play. This accumulates with the growing intensity of the feelings, until at length it diffuses itself as from a centre, awakening, as it spreads, the normal functions of the cerebrum.

In somnambulism, the peculiarity is, that while the intellectual faculties and the motory powers are in vigorous operation, that portion of the brain which receives or takes cognizance of impressions, is in profound sleep. The individual thinks, acts and moves, in obedience to internal impulses, but does not feel. The consideration of these and other phenomena, places beyond all doubt the important fact that the brain is not one organ, but a diversity of material instruments exercising widely different and independent functions.

CCCXXXVII. In the preceding remarks we have, perhaps, not strictly confined the inquiry to that class of phenomena which we proposed to elucidate. It is difficult so to restrict the investigation of them. The line of demarcation between sympathetic effects arising from *direct* external impressions, and sensations not so excited, but originally derived from such a source, is often exceedingly fine, and in a physiological point of view, of no practical importance. It is, nevertheless, interesting to study many of the phenomena of sympathy, arising independently of immediate external agencies, such as somnambulism, incubus, the speaking, crying and exclamations, in sleep, for in all these instances, we perceive the powerful working of the mind when unconscious of external objects. In this state, however, it supposes them to exist, and the imagination frequently presents them in unnatural or exaggerated relations, and hence the marvellous influence which they occasionally exercise. It is, therefore, not without reason that such phenomena have been incorporated under a particular head.

SECTION II.—SYMPATHETIC PHENOMENA ARISING FROM EXTERNAL IMPRESSIONS.

CCCXXXVIII. We now enter upon the consideration of a large and interesting class of phenomena, which have been studied with great zeal, and on which no inconsiderable light has been thrown. It was impossible for the enlightened physiologist to contemplate them, in the variety of their aspects and relations, without having his attention awakened and directed to the investigation of their source and nature. An irritation or stimulus applied to one region of the body, frequently excites the voluntary muscles of another, widely remote from the part first affected; as sneezing, coughing, or vomiting, from an irritation of the nostrils, trachea, or stomach, throws into powerful action the respiratory organs; as, also, the irritation of the uterus, rectum, and bladder, brings into energetic play distant muscles necessary to the expulsion of the fœtus fæces and urine. Tickling of the armpits or soles, gives rise to uncontrollable laughter, and occasionally to universal convulsions.

Numerous other illustrations of sympathy readily present themselves, such as the contraction of the iris from the impinging of light upon the retina; the influence of harsh or discordant sounds, in setting the teeth on edge; the copious flow of milk from the breasts, excited by the presence of the child, or even in its absence, from the pleasurable ideas it creates; the immediately invigorating effects of aliment and stimulants, both on voluntary and involuntary muscles; food in the pharynx at once sets the associated organs of deglutition in motion; the sight of what is grateful to the palate, stimulates the salivary glands, and fills the mouth with water; peculiar odours cause syncope and difficulty of breathing. It is not necessary to extend the list. The instances here given are sufficient to indicate what is understood by sympathetic affections.

CCCXXXIX. The sphere of sympathy enlarges from birth to the full maturity of the animal system. Many of those actions regarded as instinctive, such as the taking of aliment and transmitting it to the pharynx, the sucking of the young of mammals, the voiding of the stools or urine, and copulation, are constantly undergoing an important change; or, in other words, the organs on which these and other functions depend, are, at every stage of development, assuming a new and higher degree of sympathetic influence. An acute writer remarks, in reference to the particular functions stated, that they are "as perfectly performed the first time they are attempted as at any subsequent period."* This is not strictly correct. They are accomplished, but how narrow is the organic circle within which they play their part. The swallowing of the driblets of milk is the first impulse conveyed to the pharynx, but so slight is the impression, it scarcely awakens the organs associated in the process.

---

* Dr. Fletcher, opus. cit., Part II. *b.*, p. 15

This is, indeed, the first lesson they receive. Every subsequent one, from infancy to childhood, is a species of education, by which other instruments are brought into operation, and are aroused to more vigorous duties, and in the same proportion their relations to the brain and the rest of the nervous system, are augmented. Similar observations may be extended to the rectum and urinary bladder. The increase in the amount and in the nourishing quality of the food, is gradually fitting them for a wider range of offices, every step of which is evolving new sympathies. The same view applies with equal force to almost every vital action. Did space permit, it would be exceedingly interesting to trace the manifestation of sympathy throughout the transition stages of organization to its completion. The field it would open out would furnish abundant matter for the contemplation of the philosopher.

CCCXL. The phenomena, falling under the head of this section, may be studied in three different relations: first, as they occur in the voluntary muscles, the actions of which are abnormal, and are only occasionally excited; secondly, as they are exhibited by organs in the exercise of their ordinary functions; and thirdly, as they present themselves from direct impressions on the senses of sight, hearing, smell and taste. This division is, to a great extent, arbitrary, and is suggested rather for the convenience of analyzing the phenomena, than for the justness of its foundation. It is through the influence of the senses that many of the irregular muscular movements of the first class are produced. Each, however, has certain peculiar sympathetic affections by which it is distinguished, and may be examined separately with advantage.

CCCXLI. The phenomena strictly belonging to the first class, such as are exhibited by sneezing, hiccup, tickling and vomiting, early attracted the attention of the physiologist, and it was especially in reference to these and similar conditions, that sensation, as the immediate cause of them, was elaborately analyzed by Whytt and his successors. The conclusions at which they arrived, to borrow the words of a distinguished writer, prove first, that the phenomena "cannot be explained by the connexions of the nerves of the sympathizing parts; *secondly,* that they do not indicate any necessary consent or sympathy between the *individual parts of the body,* but are, in general, simply the effects of certain *mental sensations;* and that in these instances, one part of the body sympathizes with another, *only so far as the sensation, which is the natural and appropriate stimulus of the one, is excitable by irritation of the other.*"*

That sensation, or that state of the brain which co-exists with it, is essential to the production of numerous effects, is unquestionable; and it may be shown, that no sympathy, properly speaking, can exist between the nerves, the source of the original irritation, and those by which it is manifested in distant parts of the body. That they should, in a less advanced stage of physiology, have been regarded as united by some peculiar or mysterious bond, is not at all surprising. The comparative regularity with which the irritation of the one was observed to be transmitted to the other, was calculated to give rise to such impression. More enlarged views on the nervous system, will enable us to point out with greater precision, the nature of the relations associating in successive action, these two classes of nerves.

---

* Professor Alison. Medico-chirurgical Trans., supra cit., p. 171.

The first important distinction to be kept in mind, is, that the one class are nerves of *sensation*, and the other nerves of *motion*. The one may be said to terminate in the brain, as they convey to this organ the impressions from without: the other may be said to originate in it, as they derive from it the power of exciting muscular contractions. Whether guided in our views by direct experiments on the subject, or considerations which go far to establish a diversity of nervous functions, dependant on an equally diversified nervous structure, it is impossible to suppose, that that portion of the cerebrum, which is alone conscious of impressions, is the same as that whence muscular motion arises. It is, therefore, evident, that if the two classes of nerves, in any degree, sympathize, the cause is not to be sought in "anastomoses of the nerves of the parts irritated, and the parts thrown into action by the irritation," but in peculiar structural relations connecting the two at or in the vicinity of their roots.

CCCXLII. The progress of organization, from birth, to the complete development of the animal system, is one uninterrupted series of changes in nervous matter, by which these relations are gradually evolved and permanently established. The thoughts and emotions characterizing the different periods of life, are the result of these modifications, which in the first place originate in the great nervous centres, and from these the awakened influence radiates to every region of the body.

CCCXLIII. In the investigation of this particular branch of the inquiry, it is necessary to allude to the doctrines of Sir Charles Bell, and the objections which have been urged against them, by Professor Alison. The analysis of both will tend to elucidate the principles pervading these pages. The former writer observes, " looking to the simultaneous motions of the abdomen, thorax, neck, throat, lips and nostrils, in breathing, it is obvious, that they must be animated by nerves partaking of similar powers, and that *these nerves must have a centre somewhere, so that they may be simultaneously and equally excited,* and give a uniform impulse to the muscles of respiration."* " It is quite obvious, that some hundred muscles thus employed in the act of breathing, or in the common actions of sneezing, speaking, and singing, *cannot be associated, without cords of connexion* or affinity, which combine them in the performance of their actions; the nerves which serve this purpose I call respiratory."†

---

* Exposition of the Nervous System, p. 54. † Ibid., p. 76.

The objections of Professor Alison may be classified under five different heads.

First, "If it were laid down as a general proposition, or law of the system, that those nerves in the body are peculiarly apt to sympathize which arise next one another, or in a line or series above one another, various instances, in the other parts of the body, might be adduced in refutation of that idea."

Secondly, If the respiratory nerves arise from the lateral column of the spinal cord, there are other muscular nerves, *not at all concerned in the respiratory actions*, which, also, arise from it.

Thirdly, "That those of the respiratory nerves, which are the most nearly connected at their root, are by no means those which are the most closely associated in their function."

Fourthly, That a variety of muscular contractions occur in regular combinations and successions, "associated, generally, with certain actions of the muscles of respiration, yet not occurring in parts to which the respiratory nerves of Sir Charles Bell have been described as extending."

Fifthly, "The theory assigns a cause, which is uniform and permanent, for effects which are occasional and variable." "The nerves associated not only do not always act simultaneously, in obedience to the irritations applied, but that their actions accompany and succeed one another in great variety, not according to the parts where the irritations are applied, *but according to the sensations which they excite,* as was formerly illustrated at some length."*

CCCXLIV. We have not thought it necessary to give the particular facts on which these conclusions rest. Their general correctness appears to us unquestionable. The writer, however, does not appear sensible of a distinction, which it is important to make in the nature of the sympathetic phenomena, brought under consideration by Sir Charles Bell, as evidence of a connexion of the nerves at their roots, or by "*cords of connexion or affinity.*"

The appreciation of the distinction is essential to a just understanding of the phenomena. The ordinary respiratory movements of the abdomen, thorax, neck, throat, lips and nostrils, *are the effects of changes in the condition of the motory nerves,* co-operating towards the accomplishment of a specific function, not excited through impressions communicated to the brain, by *sensitive* nerves, nor, indeed, dependent on sensation, of which we are or ever were conscious, for the regular exercise of their powers. It is comparatively a matter of indifference to inquire whence they originate, because if it be a law of the system, that they shall be associated in a series of muscular contractions, these contractions, intermittent in their character, *furnish to the motory nerves the occasion necessary for their continued, yet interrupted action.* A common centre, according to the ideas of Sir Charles

---

* Medico-chirurgical Trans., supra cit., p. 214 *et seq.*

Bell, is not required to explain the regularity with which they execute their respective offices. The source of the regularity is not to be traced to the existence of a *particular* centre, but to the association of the movements themselves, and the simple fact, that the nerves are nerves of motion, or in other words, derive the principle, in virtue of which they act, from that nervous structure which is appropriated to muscular contractions.

CCCXLV. In passing from the consideration of the respiratory movements, to that of the phenomena exhibited by sneezing, coughing, speaking and singing, we enter upon the analysis of very different causes. In sneezing and coughing, we have the co-operation of the two classes of nerves,—the motory and the sensitive. An impression made upon the latter, is, at once, communicated to the cerebrum, the effect of which is to excite that portion of the organ in which the respiratory nerves are implanted, and the muscular motions resulting are proportionate to the severity of the irritation.

Numerous interesting facts go far to prove, that this is not directly conveyed from the one class of nerves to the other. *The influence of both depends on the condition of the nervous matter, intervening, or by which they are combined in successive action.* Both sneezing and coughing may be arrested in their initial manifestations, by awakening a new train of thought. We are fully aware that this is one of the strong arguments for the dependence of sympathy on sensation, the value of which, as indicative of a certain state of the brain, we are by no means disposed to underrate. The fact is valuable, and if rightly interpreted, may be shown to add considerable weight to the views, which contend for the existence of a nervous fluid. Ideas and emotions do not act independently of some such agent, in intimate connexion with nervous matter. Various circumstances have been stated in confirmation of this opinion. If, therefore, every mental state is to be regarded as employing or putting in motion a certain amount of the nervous power, the feelings induced, when the respiratory muscles are on the point of being excited, by sneezing or coughing, clearly give a new direction to the nervous principle, and thus modify the condition of that part of the brain in association with the motory nerves,—a condition essential to their free and ample exercise.

CCCXLVI. The consideration of the cause and nature of hiccup, will, perhaps, best illustrate the foregoing remarks. It arises generally from derangement of the stomach, producing a spasmodic affection of the diaphragm, and may be explained on two suppositions, both equally establishing a physical change in the respiratory nerves. The abnormal action of the stomach, whatever be its character, necessarily *disturbs the functions of its nerves and their relations to the brain.* That portion of it, in connexion with these nerves, either from irritation, or from the transmission of an impression, is so far disordered as to influence the condition of the nerves distributed to the diaphragm, and hence its irregular or spasmodic contractions. Another view may be taken of the origin of the phenomenon. It is unnecessary to expatiate on the intimate sympathy existing between the stomach, the lungs and the muscles of respiration. This is too well known to require, on this occasion, any evidence of the fact. It may, therefore, be imagined, that the nerves of the diaphragm are directly implicated in the derangement of the stomach, and hence the irritation communicated to them, is subsequently transmitted to the cerebrum.

According to either doctrine, the phenomena soliciting attention are precisely the same. We have the nerves affected in their peripheral extremities, in two different situations, the stomach and the diaphragm; and, also, that portion of the brain in which they are implanted. Hiccuping is readily removed in two ways, widely opposed in their operation, yet both equally illustrating the uninterrupted play between the nervous centre and its nerves; and we contend by restoring the normal distribution of that principle which adapts each to its respective duties.

In the whole range of sympathetic phenomena, there are few which seem so easily explicable on this supposition, as the affection in question. Sudden surprise, or the fixed attention to a particular object, will, at once, arrest it. It is, also, quickly cured by stimulants, antacids and other remedies. In the first instance, it is obvious, that the feelings, by modifying the cerebral condition in relation to the nerves, creates a new action which re-establishes their regular functions ; clearly showing, that whatever might be the nature of the exciting cause, the persistence of the affection depends on the induced state of a certain part of the brain. In the other case, where the means are applied to the peripheral extremities of the nerves, the benefit resulting consists in producing, through the media of these nerves, either a direct change in the cerebral region whence they arise, or by removing the source of irritation, allows such region to resume its ordinary action. Whichever conclusion be adopted, it seems almost impossible not to trace, in these effects, the operation of a nervous agent subject to constant variations in its distribution.

CCCXLVII. The same views are likewise strongly corroborated by the means employed to resuscitate an individual in syncope. The dashing of cold water upon the face, or the application of stimulants to the nostrils, excites the animating principle in the nerves, and thereby occasions a commotion in the brain, the result of which is, returning sensibility and the gradual re-establishment of the functions of life. Those who argue that sympathy depends entirely on sensation, urge such facts as evidence of the truth of their reasoning. Its importance, as a cause, we do not question, indicating, as it does, a certain cerebral state. But what produces that change in cerebral matter anterior to the manifestation of sensation?

Do the nerves carry no stimulating power from their peripheral to their central extremities? It is this which is put in motion from without, and, by its awakened vigour arouses the energies within.

CCCXLVIII. It is further remarked by the same enlightened physiologists, in their advocacy of sensation, as the cause of sympathetic affections, that when this cannot be excited in syncope, external irritants fail to produce the ordinary phenomena. But what does it prove? If it shows, on the one hand, by negative results, the potency of sensation, on the other, it equally demonstrates a condition of the brain, or its associated nerves, (most probably of both,) which the remaining nervous principle is incapable of influencing.

CCCXLIX. In exhibiting the efficiency of sensation, as the source of sympathy, the inquirer has left altogether out of consideration, a change in cerebral matter antecedent to the manifestation of sensation,—a change which must be effected by some pervading principle which is the natural stimulus of such matter. What is this but the animating agent of the nervous system?

CCCL. The sickness and vomiting which frequently present themselves in the early months of utero-gestation, may be shown to furnish additional illustrations in support of the foregoing train of reasoning. It is not difficult to suggest a rational explanation of their origin. The new action set up in the uterus, (and every action begins in the nervous system,) becomes clearly a vital centre, gradually augmenting its demands upon the nervous fluid and blood. These demands, especially in those delicately constituted, must necessarily influence all organs in their immediate vicinity, the evidence of which is displayed by parts either the most susceptible of derangement, or whose abnormal symptoms are the most obvious to ordinary observation. Among this number the stomach claims particular attention. What is the physiological effect of the newly-created action? Is it not to withdraw from the nerves distributed to this organ a portion of their stimulus, or in other words, the nervous fluid? The result which follows, *is the disturbance of the relations between these nerves and the brain.* Both may be regarded as having acquired an extraordinary degree of excitability, which disappears during the progress of gestation. The stomach, and all parts of the animal system, gradually adapt themselves to new conditions, and that which was, in the first instance, the source of a variety of distressing symptoms, becomes subsequently a healthy and an invigorating process.

CCCLI. In cases of vomiting from medicinal agents, the same explanation applies. The nerves are disordered in their peripheral extremities to such a degree, that the normal relations between them and the brain are broken: new actions are set up both in this organ and the stomach, which increase in severity, until at last the induced relations excite the cerebrum to vigorous re-action, and hence the violent muscular contractions which follow. It is true, that unless this organ were sensible to impressions, none of these sympathetic phenomena would take place. But the inquiry naturally is, what leads to the manifestation of them? Are the aroused muscular movements the result of no animating power in the nerves? Have these received no addition of that principle in virtue of which they act under ordinary circumstances? Is the augmented force to be ascribed to the mere irritation of the nervous fibre, or a modification in the condition of its molecules, independently of a vivifying agent imparting to them their vitality and energy of action? There is only one conclusion, in contemplating these phenomena, at which we can rationally arrive, *viz.*, the existence of a nervous fluid, the changes in the distribution of which, are the first links in the derangement of the stomach and the brain, and are not only anterior to, but the cause of the sensation co-existing with that state of the cerebrum, which impels to violent contraction a variety of muscles.

CCCLII. The depraved appetite which occasionally manifests itself in pregnancy, is explicable on the same considerations. Whether sickness, fainting, epileptic or hysterical attacks, vomiting or a vitiated taste, be one of the accompanying indications of the disordered nerves of the stomach, depends on circumstances beyond the means of analysis. It is impossible to ascertain what may be the extent of the morbid relations they establish with the brain. According to the character of these will be the nature and variety of the sympathetic affections. It is, however, important to remark, that how diversified soever they may be, the nervous conditions out of which they arise, are conditions, the initial steps of which are the consequences of imperceptible physical changes in the nerves and nervous organs implicated, occurring independently of the co-operation of sensation, from the altered distribution of the nervous energy. Every modification of it is a proportionate change of vital action. Sensation, or that state of the brain which it indicates, is necessary to the development of these phenomena, but while admitting this, let us not forget the nature of the foundation on which it rests, or the induced nervous changes out of which it springs.

CCCLIII. Among other phenomena adduced by Sir Charles Bell, as evidence of a common nervous centre, or of actions, the muscles concerned in which "*cannot be associated without cords of connexion or affinity*," are singing and speaking. In the previous observations, we have briefly glanced at two important classes of sympathetic affections, and have attempted to show that a nervous centre, according to the ideas of this distinguished physiologist, is not necessary to account for them; that in fact the nerves which receive the irritation or impression transmitted to the brain, have no direct connexion with those which display the effects in distant parts of the body. In analyzing the nervous conditions of singing and speaking, the consideration of a common nervous centre, save that of volition, does not naturally present itself. In these instances the nerves are controlled by the will. It is this power which regulates their exercise, as well as that of every voluntary motion. In whatever part of the cerebrum the will resides, by an undeviating law of organization, it is evidently in such relation to the nerves that these instantaneously obey its mandates. It is comparatively of little importance in this inquiry into sympathetic phenomena, to determine the particular origin or association of the nerves. If their co-operation in the production of certain effects, be regarded as evidence of sympathy, it is sympathy developed by the immediate influence of volition. From birth to the completion of the vocal organs, every effort which is made to give utterance to the thoughts, is strengthening the power of the will, the nerves and the organs which it calls into play. It is the process which nature adopts to accomplish the necessary physical arrangements among these several instruments.

CCCLIV. We shall now say a few words on those sympathetic actions which may be designated functional, being exhibited by organs in the exercise of their usual offices. The contraction of the iris, from the impressions of light upon the retina, is one of these. The phenomenon can with as little propriety be ascribed to sensation, as the muscular motions of the heart, stomach, and intestines. If the retina be insensible to impressions from structural changes in it, or from cerebral disease, the iris is immoveable. This does not prove that *sensation* is essential to its contraction. In the one case, it is evidence that the sensibility of the brain is necessary to the result. The cerebral condition which it implies, is a condition requisite to reflex action, and for the purpose of bringing into harmonious relation the various instruments co-operating in the function of vision; in the same manner as a certain physical state of the spinal cord, is indispensable to the production of a similar class of phenomena.

CCCLV. We will endeavour to define clearly the ideas we attach to the term sensibility, which is essentially necessary in investigations of this kind. It is a property of the nervous system, in virtue of which living beings are rendered susceptible of pain and pleasure, which may be excited by a variety of causes directly affecting the conditions of the nerves, or by thoughts and emotions which spontaneously arise. All parts of the body are abundantly endowed with nerves called *sensitive*, that is, nerves in such relation to the sensorium that every strong impression they receive is at once transmitted to it. Thus we are conscious of the sensations resulting, or in plain language we feel.

It is not to be supposed that the office of these nerves is restricted to the conveyance of either pleasurable or painful impressions: this is the extreme exercise of their functions,—their occasional action only. They are the media of endless impressions, *or the seat of changes which are constantly modifying the physical properties of the brain in relation to them*, of none of which we are conscious; and yet these could not possibly take place did not the brain possess its natural sensibility, or exist in a state susceptible of impressions of which we may be made conscious. Of the agents, both from without and within the body, unceasingly exciting these changes, many will readily occur to the mind. Among them may be included numerous circumstances accompanying the vicissitudes of the seasons,—the alternations of temperature, all influencing, more or less, the condition of the nerves, but not in a degree sufficient to attract attention to themselves; and the same may, also, be observed of a variety of internal vital operations.

It is true we have no evidence of these effects that will satisfy the understanding doubting everything that does not fall under actual observation,—is not capable of being measured or handled. We have no means of analyzing the physical changes which, during every moment of life, are taking place in the nerves and, through their instrumentality, in the brain. If we consider, however, the office of the nerves, and the obvious consequences flowing from their activity, it would be unphilosophical to deny the vast part which they silently but efficiently play in the animal economy, maintaining the whole in mysterious bonds of sympathy, from the existence of that state of the cerebrum designated sensibility, and yet not so exciting it as to render us conscious of their influence from the *sensations* resulting.

CCCLVI. Numerous illustrations might be given of the necessity of a limited degree of sensibility for cerebral operations, strictly speaking, unaccompanied by sensations, which should be understood as implying a something of which we are conscious. The contraction of the iris, from the impinging of light upon the retina, will enable us to explain our views. For the production of the effect, a certain amount of sensibility is required so that *the brain may be susceptible of the impressions of light.* In treating of these matters, it is scarcely possible to employ language that does not express an hypothesis. The susceptibility and the impressions are instances of the kind. How the phenomenon follows the action of the external agent, we know not. All that falls under observation, are certain general circumstances which constantly accompany its manifestation.

The susceptibility is proportionate to the sensibility, increasing and diminishing with every change in the latter. It is indeed the only evidence we have of the existence of sensibility. We may, therefore, imagine such a degree of it as is essential to the contraction of the iris and the production of other phenomena, and yet not so affected as to give rise to impressions of which we were ever in any way conscious, consequently, sensibility exists independently of sensations.

CCCLVII. In close connexion with this branch of the inquiry and demanding particular examination, are the relations between consciousness and sensibility. The nerves of the senses are simply instruments for the purpose of exciting a variety of physical changes in the brain, of which consciousness, or that faculty that gives to every living being its individuality, takes cognizance. The field of its operations enlarges with every addition of cerebral matter, and hence it is impossible to avoid the inference, that, like every other mental power, it has its definite locality, and in such association with that portion of the cerebrum, shown by the researches of physiologists to be peculiarly sensitive, and to which impressions, through the nerves of common sensation, are unquestionably conveyed, that it is ever ready to attend to the intimations received from without. As we descend in the scale of organization, its range of action is narrowed, until, at last, the nervous structure in which it exists only just displays evidence of animal life.

It must not, however, be supposed, when from sleep, or other causes, consciousness is at rest, that numerous cerebral operations, dependent on sensibility, or that state of the brain which indicates its presence, by the susceptibility of being influenced, are not carried on with uninterrupted regularity. The physical changes in the nervous system continue proportionate to the demands made upon it. Sensation, awakening consciousness, is only one of several causes affecting the flow of the nervous principle and the production of vital phenomena.

CCCLVIII. Each of the senses has unquestionably its own particular cerebral organ, precisely as the nerves of motion and sensation have equally their independent regions, and the office of the organ is to receive the impressions from without; or, in other words, the irritation at the peripheral extremities of the nerves, by a law of the animal system, sets the nervous energy in motion, the effect of which is to place the *internal* organ in a position to respond to the external requirements; hence the variety of modifications in the form or action of the external instruments of sight, hearing, smell, and taste. These modifications,—save when volition comes into play, are largely due to the individual organs excited, which are structurally, as well as functionally in exquisite harmony with the complicated mechanism of the entire brain, and they can act only as long as the relations which bind its numerous parts together are preserved.

CCCLIX. Insensibility disturbs the internal nervous conditions essential to reflex action, of which the contraction of the iris, from the influence of light upon the retina, is an illustration. It does not result from any species of feeling, but from an organic condition as independent of it as are similar effects occurring within the domains of purely organic life. It presents itself unquestionably under very different circumstances, but these do not alter the nature of the causes out of which it springs. That state of the nervous system in which it originates, is indicated by sensibility, and the internal organ through the instrumentality of which it is manifested, has, on the one hand, an exceedingly complicated external apparatus to govern; and, on the other, has internal relations far more diversified to maintain; the nervous energy, however, acts from within, outwards, giving rise to reflex phenomena, from organic conditions belonging to the internal organ of vision and its associated nerves.

In the other instances, to which the term reflex action was originally applied, the parts which exhibit it are simpler in structure, and the functions they exercise, *per se.*, less varied and refined in character; hence the corresponding difference in the nervous conditions out of which the phenomena are evolved.

CCCLX. The same views apply, also, to the explanation of the action of the muscles of the two eyes, preserving the parallelism of the optic axes. The muscles are said to sympathize with each other. They have been subject to the same nervous conditions from birth, and have been equally influenced by all the circumstances accompanying the exercise of vision; and, therefore, the relations which are established between each other and the brain, are almost as permanent and unvarying as those which connect the iris and the retina.

In treating of the action of these muscles, it is observed by an exceedingly acute writer, and one to whom physiology is under deep obligations, that, "what renders this question still more intricate is, that three nerves are employed to supply the six muscles that have been described. The fourth nerve supplies the obliquus superior; the sixth supplies the rectus externus; and the third supplies the remaining muscles. It is remarkable, again, that of the six muscles of the eye-ball, three turn the optic axis directly or obliquely outward, and that each of these *three muscles is supplied by a different nerve;* two, indeed, have an entire nerve exclusively distributed to each of them.

" It appears to be a principle universally observed in the construction of the nervous system, that nerves of motion rise near the origin of those sentient nerves, through which the actions they controul are habitually guided or called into play."*

CCCLXI. The difficulty which is experienced in explaining the simultaneous or harmonious action of these muscles, from the fact that they are supplied by different nerves, does not exist in connexion with the views here laid down. The writer, in the concluding part of the extract, evidently imagines that the nerves rising near each other, as from a common centre, will go far to account for the phenomenon. Several nerves, which act in unison, do not appear to have this structural connexion; nor is it necessary to elucidate the sympathetic conditions by which they are associated. All that is required is, *that they shall be nerves of motion, and shall have been brought into simultaneous action by the same circumstances.* The sympathy, which the muscles display in their movements, is the result of their constant co-operation,—their uninterrupted connexion in the exercise of these functions. The nerves by which these are regulated, and on which they depend, are not restricted to the same structural point for the principle by which they are animated. It may be comparatively a matter of indifference to determine whence it is derived. The unvarying combinations in the performance of their office,—combinations which have been gradually established from birth, will satisfactorily explain why the same causes should excite equally those muscles whose motions were designed to be consensual.

---

* Outlines of Human Physiology, by Herbert Mayo, F.R.S., p. 393.

The iris receives nerves from two sources, from the sentient part of the fifth and from the third; and experiments go far to establish that its contractions depend on the latter nerve. They are excited in a pigeon, after the head is cut off and the entire brain is removed, by irritating the nerve while it remains attached to the eye. And if it be divided in the cranial cavity, while the animal is alive, the iris appears to be instantaneously paralyzed.* Whatever be the source of its nervous power, its contractions arise from the impinging of light upon the retina, and the effects produced in this organ set the complicated apparatus of vision in motion.

CCCLXII. Mayo and others are of opinion that the contraction of the pupil is often voluntary; and the former instances the changes which it undergoes in the hawk or the cat, when the attention of the animal is bent upon an object which does not shift its position. He says, "it is probably employed in examining the object under different lights by intentionally admitting more or fewer rays through the pupil." This implies a knowledge of the end to be attained which is scarcely probable. The object, unvarying in its position, is gazed upon with extraordinary interest,—with feelings powerfully excited, and these acting instinctively will modify not only the action of the iris, but other muscular motions. The attitude of the cat, when its attention is excited by a suspicious noise, or when on the point of springing upon its prey, is prompted by these feelings. It is these which adapt the means to the desired purpose.

---

* Mayo, Opus. cit., p. 377.

It is stated that Dr. Roget has the power of contracting the pupil, at pleasure. We do not doubt the fact; nor that volition may be equally efficient in some of the lower animals. The question is, nevertheless, fraught with considerable difficulty, arising from circumstances which may not have been clearly apprehended. The action of the iris does not entirely depend on the amount of light transmitted to the retina. That the iris will contract according to the amount impinging upon it, is admitted, but this does not imply any contradiction. Its ordinary physical effect may, however, be altogether counteracted by the emotions excited. These will modify the capacity of the pupil independently of the external stimulus; and, therefore, when these emotions arise, or when the mind makes an effort which may cause the iris to contract, it is not easy to ascertain how far this phenomenon *is due to the direct exercise of volition, or to a condition of the brain which these emotions or this effort may induce.* The distinction which is here pointed out is worthy of consideration.

CCCLXIII. In the same class of sympathetic phenomena, we have the contraction of the diaphragm and abdominal muscles, from the irritation of the rectum in the occasional exercise of its function. The mental feeling which arises, is proportionate to the existing necessity, and the brain calls into requisition a variety of powers, partly under the controul of volition, but largely awakened by the prevailing emotions, which have at command a vast amount of sympathetic influence. Hence the result of the co-operation of these powers. Though the nervous connexions, on which these depend, are perfect at birth, the sympathy which they exhibit subsequently, is mainly to be traced to the circumstances by which they have been slowly and imperceptibly developed. They are in the same position as the faculties of the mind. A modification in the quality and quantity of the ingesta, effects for the one, what the comprehensive resources of education, accomplish for the other.

CCCLXIV. In the exercise of these and other muscles, during the process of parturition, we have a remarkable confirmation of the truth of these remarks. No previous circumstances have prepared them for the wide class of sympathetic operations which are suddenly called into activity. These have to be excited and combined by extreme and protracted suffering. Recent discoveries, however, show that this is not necessary, as the end may be attained while the individual is insensible from the agency of chloroform or ether. The fact is highly important in a physiological point of view, and strengthens materially the principles pervading these pages. It shows that sensation, which is regarded by many distinguished authorities as almost the only important cause of sympathy, may to a large extent be dispensed with. The consideration of the phenomenon will not inaptly illustrate these principles. The contractions of the uterus, excited by its contents, gradually increase, every one of which is not only drawing to the organ a greater amount of nervous energy, but enlisting into its service the aid of a variety of muscles, the number and contractions of which go on augmenting, and, at every step, with aggravated demands upon the animating principle of the brain and spinal cord, until the efforts of nature are equal to the expulsion of the fœtus.

CCCLXV. Cases of this kind present on a magnificent scale the phenomena of reflex action, displaying the associated energies of all parts of the nervous system, independently of sensations of which the individual is conscious; or, if any such exist, *their acuteness bears no ratio to the extent and severity of the muscular motions excited.*

We have, in these instances, a striking illustration of the law which we have laboured to establish, and to exhibit its application, *viz.*, that the nervous agent flows to all organs according to their activity, and that the phenomena resulting are proportionate to its concentration.

CCCLXVI. The act of deglutition is another of those processes which exhibit the consensual action of parts from the pervading principle of sympathy. The powers called into play are partly voluntary and instinctive. The different motory nerves which cooperate in the function, whatever be their origin, have been gradually broken in to associated movements, and the entire of those which are sympathetic are immediately aroused by the presence of food in the pharynx. Concerning the mechanism, by which this is conveyed into the esophagus, it is not our business to inquire.

CCCLXVII. We shall now say a few words on the sympathetic affections arising from direct impressions on the organs of the senses. There are points connected with the consideration of them, which have not been studied in the foregoing remarks with the attention they deserve. We shall first examine the phenomena belonging to the exercise of sight. We have endeavoured in a previous work,* to trace the changes in the amount of cerebral substance, in relation to the nerves of the senses, in the different classes of the lower animals; and, also, to exhibit the effects of these changes on the activity or sphere of influence of these nerves. This inquiry bears intimately on the subject of sympathy. It establishes one important fact, *viz.*, that every modification in the amount of cerebral matter, has its particular *external* manifestations, varying with the occasions which affect the condition of the cerebral organs. The same law applies likewise to the human race. In no two cases have the nerves the same relations to cerebral structure, either in regard to its quantity or quality, hence the diversified expression of which the countenance is susceptible, and the distinctive character which marks the features of every individual.

---

* The Philosophy of Animated Nature, &c.

CCCLXVIII. If permitted to assume the existence of a nervous fluid, it follows from these, and numerous facts of the same kind, that it is proportionate to the amount of nervous matter:—that in fact it is a something as inseparable from organization, as that principle which gives to metals their electric or galvanic properties; and, in common with it, is constantly varying in its relations to the molecules with which it is connected.

CCCLXIX. In man, the organ of sight is largely intellectual in its operations. It is instrumental in awakening the most elevated of his emotions, and the most ennobling of his contemplations.* The reason is obvious: the nerves which minister to this end, have cerebral connexions proportionate to the comprehensive character of the functions exercised. The phenomena and the cerebral matter are reciprocally a general measure of each other.

---

* The just and beautiful observations of Addison on this subject, will readily occur to the reader: "Our sight is the most perfect, and most delightful of all our senses. It fills the mind

CCCLXX. The influence we possess, through the aid of mesmerism, of exciting, when the individual is altogether unconscious, thoughts and feelings, as well as changing them at pleasure; and further, the power of arresting the articulation in the middle of a word, the latter half of which presents itself on re-establishing the previous state of the brain, are effects we have repeatedly produced.

We have studied them with intense anxiety,—with an interest proportionate to their importance, throwing, as they do, a flood of light on the constitution of the mind, its laws and mode of action. They place beyond all doubt the indissoluble connexion between ideas and the nervous principle, and enable us to trace, as far as the analysis of such phenomena permits, the manner in which the former excites or depresses the powers of life.

CCCLXXI. Were we to interrupt the course of the blood in any part of the body, the diminution in the vital energies of the latter, would be evidence of the fact,—would exhibit the dependence of these energies on the fluid withdrawn. Cause and effect, in this instance, would be apparent to the most ordinary

---

with the largest variety of ideas, converses with its objects at the greatest distance, and continues the longest in action, without being tired or satiated with its proper enjoyments." No. 411 of the *Spectator*.

observation. But when we perceive ideas and feelings awakened, changed or instantaneously arrested in the articulate expression of them, by the exercise of a physical principle common to the animal economy, which may be transmitted to, or perhaps in less objectionable terms, may be so aroused in another, as to produce a manifest alteration in the character of the vital functions, it is regarded as premature and unphilosophical to deduce similar conclusions from such premises. It is true, that, in the one case, the agent may be seen, felt and examined; and, in the other, that it does not fall under the cognizance of the senses. The effects which follow the modification of its conditions, are nevertheless, as indisputable as those which accompany the varying states of the circulating fluid, and are equally legitimate objects of investigation.

CCCLXXII. We do not presume to define the exact structural relations between the brain and the special organs of the senses. It is sufficient to know that these are the inlets of all impressions conveyed to it, and that the medium, by which parts endowed with widely different functions are associated together, is one pervading nervous principle. By a law impressed upon animated matter, each nerve has its particular sphere of cerebral influence. Why objects acting upon the visual organs, have the power of exciting a variety of thoughts and emotions, we know not; but elaborate experimental researches go far to prove, that the mental phenomena, whatever be their nature, are dependent on one nervous agent; and that the altered distribution of it, is both a cause and an effect of every modified condition of the mind. When the ideas which arise are of a lively description, the nervous energy displays its enlarged *external* relations—the eye is warm and glowing in its expression: if particularly pleasurable, it is suffused with tears. Its vessels are stimulated to increased action by a correspondingly excited state of the brain,—a state which permits the nervous fluid to flow in augmented quantity from within, outwards.

When, however, the sorrow is intense in degree, no tears indicate its presence. The cerebral energies are concentrated to one point. The channels through which they communicate with the external world, are only partially used. The nervous principle is not withdrawn simply from the eye, but from every feature and from every part of the animal economy. Is there not in these cases a modification of some power inherent in the nervous system,—a power which presides over vital action wherever it exists, and like the blood subject to changes in its distribution?

CCCLXXIII. How different are the sympathetic effects manifested by the two extremes of grief—the one slight and of brief duration—the other deep and lasting, or of prolonged continuance. In the one, the countenance quickly regains its usual expression, the body its ordinary elastic movements, and the digestive apparatus, only occasionally affected, its normal activity and force. The flow of tears is proverbially a relief to the mind; in more precise language, *it is a relief to the physical condition of the cerebrum.* It allows this organ, for the time disturbed in its functions, to recover its natural tone, and to re-establish its vigorous and comprehensive relations to the animal system.

Where the sorrow is profound, the gaze is fixed, the eye scarcely gives evidence of thought, the features are immoveable, and the limbs are no longer in active exercise. The existing state of the brain, shuts out the stirring and healthy influence of external objects. Hence the gradual wasting of the flesh and the deterioration of the powers of life. If we consider, that according to the intensity of the ideas or emotions, is the amount of the nervous fluid held in subjection or withdrawn from its regular channels, it is not difficult to account for the particular sympathies which distinguish each case.

CCCLXXIV. Impressions made on the organ of sight occasionally give rise to extraordinary nervous phenomena. Hysterical and convulsive affections have spread from one individual to many with almost the instantaneousness of thought. These have, perhaps, invariably occurred among females, whose minds were peculiarly excitable from religious enthusiasm or strong devotional feelings. The circumstances out of which they originate, or with which they are intimately connected, it is important to keep in view. Indeed the consideration of them is essential to explain the results. The nervous system is, in all these instances, in a highly susceptible state, characterized by the same general conditions, has been influenced by the same general causes, and corresponding emotions and ideas have prevailed throughout the entire body of the individuals. As fire extends from one combustible material to another, with a rapidity proportionate to their inflammable nature; so the impressions will be propagated through a number of persons, according to the excitability of the nervous system common to the whole. This is on the point of explosion. It requires only the necessary external circumstance to give expression to the pent-up and ill-regulated feelings.

In all these cases the impressions are irresistible; the phenomena, however, they awaken will not be precisely alike in any two, from constitutional and other differences, but the whole will exhibit a uniformity which cannot be mistaken.

CCCLXXV. It is, also, through the eye that we are strongly affected by theatrical and other representations. Our sympathies are variously excited. The extreme sufferings or triumphs of others, when eloquently depicted, have a power at times far greater than the real occurrences of life, and probably from this cause: that in the one instance, the mind is gradually prepared and wrought up to a high pitch of interest, until, at length, there is a breathless anxiety, the whole soul is riveted to the incidents on which the issue of the conflict depends, and, in the intensity of its feelings, though only for a moment, forgets that the whole is fictitious. In the other case, the conditions are widely different. The objects by which we are influenced, frequently occur abruptly, which to those personally concerned may be the occasion of the most poignant emotions, but not equally so to the casual observer; or if presented in regular successive order, it is seldom in that close association distinguishing the creations of the poet; nor are they heightened by those touches and combinations of genius, which are nevertheless, true to nature,—but nature in her happiest or most awful moods. In the one instance, the events gathering force at each step, rapidly converge to a focus; in the other, if pursuing the same course, the succession is less distinct or definite, from the breaks or interruptions in the emotions arising from the obtruding and casual incidents of real life.

CCCLXXVI. It can scarcely be doubted that in scenic representations, the mind occasionally is so carried along by the inimitable talent of the actor, as to lose sight of the distinction between the simulated and the stirring actions of life. The involuntary exclamations and sobbing, which are not unfrequently excited, are evidence of the fact. And the argument is further strengthened, by taking into consideration the age, sex and constitutional tendencies of those, who are peculiarly liable to be affected. It is the few only endowed with acute sensibility, or possessing a comparatively limited understanding, that can be thus powerfully influenced.

CCCLXXVII. The striking difference in the intensity of the feelings, from the character of the phenomena which precede a catastrophe, will present itself with a variety of illustrations to almost every mind, and the contemplation of them will tend to confirm the justness of these remarks. If while walking on the sea-shore, our attention is directed to a boat, at a distance, and the moment it is seen it is upset and all hands perish, we feel and necessarily strongly. Our sympathies will unquestionably be excited, but how much less in degree, than if we had watched for a considerable time, the toils and the struggles of the men, their daring and enterprising efforts to keep the frail bark afloat, at one instant lost from our view, at another, riding high on the foaming surge, mountain and gulph, like our hopes and fears, alternating, all which circumstances mutually concur in producing the most intense emotions of which human nature is susceptible. We make involuntary movements to assist them. The hand, the foot, the voice, the whole body are instinct with unavailing sympathy.

CCCLXXVIII. The sense, next in importance, for its range of influence, in the higher classes of animals, is the sense of hearing. Like that of sight it is largely intellectual. In man it ministers to some of the most exquisite of his pleasures, not simply from the variety of knowledge of which it is the medium, but as a channel through which impressions awaken the most refined of his emotions. The effect of these on the expression of the eye and features, and on the motions and attitudes of the body, is familiar to every one;

and it is restricted to no age or class of society. It is exhibited by the infant and the adult, by the savage, and throughout every gradation of civilization. With what rapture the young child listens to the rudest strains of music, and with what instinct and delight its feet move in harmony with the varying notes!

CCCLXXIX. The diversified influence of music on mankind clearly shows, that to hear, is only one of the elements essential to its enjoyment. A peculiar sensibility is required, or in other words, a peculiar cerebral organization, for on this every variety of mental character depends. Culture or education may improve a faculty,—may give it a delicacy, and to some extent, a justness of perception; but if nature has not laid a broad foundation on which to operate, the best directed efforts will not supply, but may partially conceal her deficiencies.

CCCLXXX. Many ingenious hypotheses have been formed to explain the cause of the remarkable differences among mankind, in regard to the susceptibility and the accurate appreciation of sounds. Some of the highest authorities have endeavoured to trace it to peculiar structural conformations of those parts of the internal ear, which receive the sonorous impressions. It is impossible to say that such conformations may not be instrumental in the production of the phenomena. Important facts, however, are opposed to this view. The destruction of the membrane of the tympanum, and other diseased conditions of the auditory apparatus, which do not affect in any degree the sensibility to music, are unfavourable to it.

An exquisite delicacy in the faculty of hearing, has clearly little or no connexion with what is designated a musical ear. The cerebral or mental effects resulting from impressions upon the organs of sight, hearing, smell, taste and feeling, though widely different in their nature, are all equally to be referred to the brain which takes cognizance of them. The modifications in its constitution are the cause of all their variety.

An admirable philosopher, and one whose writings have a charm which few possess, has some excellent remarks on the senses in connexion with the association of ideas, which bear intimately on the present inquiry: "The peculiarity in the case of visible objects," he observes, "seems to arise from this; that when we think of a sound or of a taste, the object of our conception is one single detached sensation; whereas every visible object is complex: and the conception which we form of it as a whole, is aided by the association of ideas."* The distinctions which he here points out are mainly founded in truth. They suggest, however, a remark, less, perhaps, to correct a fallacy, than to limit the application of the views, or to show how far they are liable to be modified by circumstances. The recollection of a sound or of a taste, will in some minds be richly fraught with associations. To the musician, the former, will occa-

---

Elements of the Philosophy of the Human Mind. By Dugald Stewart, Vol. I., p. 136.

sionally be a spell of marvellous potency. It will awaken a long train of ideas, and emotions as pleasurable as they are varied. To the gourmand, or sensualist, the recollection of a taste, which gratified his palate, and on which he has often dwelt, will not present itself as a detached sensation. It will bring along with it, the time, place and company, and numerous incidents with which it is indissolubly connected.

CCCLXXXI. The associations take their complexion and character from the prevailing qualities of the mind. Taste, which in man plays a subordinate part, in comparison of sight and hearing, excites, in many of the lower animals, the most intense feelings. Here the associations are largely in relation to this sense. The same may, also, be observed of that of smell; and the study of the phenomena of both, will display in a strong light, the principles which regulate the association of ideas throughout the greater part of animated nature.

CCCLXXXII. Dugald Stewart, in treating of the faculty of attention, expresses an opinion in reference to the perception of sounds, during sleep, which has always appeared to us exceedingly questionable. "A person who falls asleep at church," he observes, "and is suddenly awaked, is unable to recollect the last words spoken by the preacher; or even to recollect that he was speaking at all. And yet that sleep does not suspend entirely the powers of perception, may be inferred from this, that if the preacher were to make a sudden pause in his discourse, every person in the congregation who was asleep, would instantly awake. In this case, therefore, *it appears, that a person may be conscious of a perception without being able afterwards to recollect it.*"*

We do not regard this explanation as strictly correct. Sleep has many degrees. It may be exceedingly profound and broken with difficulty, or it may be slight, as in the instance alluded to by the philosopher. The relations between the organs of the senses and the sensorium, are modified in all these varieties. By these modifications are to be understood, different co-existing states of cerebral or mental activity, with which the conditions of the sense of hearing, are always in harmony. This activity does not necessarily imply a consciousness of impressions. Those which are repeatedly made upon the ear by the preacher, keep in subdued play the nervous energy between the external auditory apparatus and the brain. The sudden interruption to the regular continuance of the sounds, at once destroys the previous relations between these several organs. A new mental condition is the inevitable result. The instantaneous cessation of the impressions, under these circumstances, is, in reference to cerebral operations, equivalent to their direct influence. The abrupt withdrawal of the impressions, immediately gives rise to a new state of the sensorium, which is that of waking. The writer, in his boyhood, resided in the vicinity of a large forge, the hammer of which was constantly going during the day. The noise was always remarked by visitors as a disagreeable annoyance, by the family, however, it was not heard; but the moment it ceased, a strange sensation was felt. The pause was the occasion of new feelings. The family had not the consciousness of the successive sounds, nor has the sleeper in the church of the voice of the preacher, yet in both cases, the impressions unquestionably create and maintain a particular functional state between the nerves of hearing and the brain, as is manifested by the sensations arising on their interruption.

---

* Opus Cit, Vol. I, p. 103.

If the philosopher, in place of contending for the perception of the external object, during sleep, had endeavoured to show that a certain degree of sensibility, not necessarily implying consciousness, continued; and that the phenomena were explicable on changes induced in the nervous system from the persistence of this sensibility, though we are not conscious of the external impressions, he would have been nearer the truth.

CCCLXXXIII. The sense of smell has an extraordinary sympathetic influence on the animal economy. It may awaken the most delightful as well as the most repulsive of sensations. An agreeable fragrance sheds around every object which possesses it, an additional charm; and we are far from being conscious of the amount of its contributions to our enjoyments. In the lower animals, it has a particular relation to the animal desires, and in combination with the sense of taste, serves the important office of a sentinel against the introduction of matters that might be detrimental to the system.

A fragrance, which to one person, is delicious, will in another produce syncope; and in some, so marvellous is their sensibility, that if the object be not seen, and by no means powerful in the odours which it emits, if in the room, it is immediately detected, and the ordinary effects follow. Here the imagination is altogether inoperative. An impression is clearly produced upon the organ of smell, and appears to act as a direct sedative on the sensibility of the brain.

CCCLXXXIV. The sense of taste, appertains, in a peculiar degree, to the animal passions. Its range of sympathetic action increases from man downwards. In some of the lower animals, the emotions which it awakens almost border on the sublime from their appalling intensity. In man it is, also, the source of considerable gratification, and plays no unimportant part in the animal economy. By culture, its perceptions are capable of being rendered exceedingly delicate, and in proportion as it becomes refined, it exercises the higher mental powers. It is never, however, largely intellectual in its influence. The extent of the sympathies which it excites, depends greatly on the attention which is given to it. Among the bulk of mankind it is scarcely an object of consideration. The difficulty experienced in procuring the necessaries of life, leaves little room for the suggestions of taste. But though narrowed in its sphere of operations, nature, true to herself, augments its sympathetic agency in relation to the glands with which it is associated in the process of mastication. Where the food is coarse and obtained at long intervals, the zest with which it is taken compensates in some degree for the absence of those qualities, which, in the more favoured classes of society, are often indispensable adjuncts not only to create an appetite, but to stimulate the various glands to the performance of their ordinary functions.

SECTION III.—ORGANIC SYMPATHETIC PHENOMENA.

CCCLXXXV. The wide class of nervous affections, comprehended under this head, are generally supposed to be explicable on the continuity or the contiguity of the parts which are mutually influenced, independently of the co-operation of the brain. That such relations frequently exist in the numerous instances brought forward in illustration of organic sympathy, is unquestionable. We shall, however, endeavour to show that the consideration of the mode in which the effects are produced, goes far to establish the pervading agency of the nervous fluid. In fact that they are to be traced to modifications in its distribution whether occurring from the natural development of organs or the manifestation of disease.

CCCLXXXVI. The changes in the condition of the mammæ, contemporaneous with every alteration in the action of the uterus, are adduced as evidence of this species of sympathy, and it is an example peculiarly calculated to interest the inquiring mind. In early life, when the amative propensity does not exist as a stimulus to the nervous system, the breasts are scarcely perceptible. At puberty, when the passion gradually increases in force imparting new energies to every function, they are augmented in prominence and sensibility. It is scarcely necessary to remark, that during the period of gestation their enlargement is progressive, and, that at the termination of this process, the character of the important office they perform seems to be a measure of the vital properties previously engaged in the formation of the fœtus. The activity of one region is translated to another. When the uterus is no longer capable of performing its ordinary functions, the mammæ usually become flaccid and often almost entirely disappear.

CCCLXXXVII. The influence exerted by these organs on the generative system does not justly come under the designation of organic sympathy. The powerful effects which the titillation of the mammæ occasionally produces, awakening, under certain circumstances, the most violent desires, are to be ascribed to the mental sensations to which it gives rise. In proof of the correctness of this observation, if any were required, similar feelings may be excited by toying with almost any other portion of the cutaneous surface.

CCCLXXXVIII. Were we to analyze minutely the sympathetic relations existing between the uterus and the mammæ, as displayed in the examples above alluded to, it might be shown that these are not pure illustrations of organic sympathy, by which is understood the transmission of impressions from one organ to another, either from their continuity or contiguity, independently of the direct co-operation of the brain.

The sympathy is of a mixed character. It is in part owing to the nervous connexions by which these several organs are associated, a change in the nerves of the uterus being immediately communicated to those of the mammæ; and is, also, largely to be traced to a state of the nerves of the latter in harmony with the co-existing condition of the brain and spinal marrow,—a condition chiefly produced by them. At puberty, and subsequently, the excitement of the generative apparatus arouses these nervous centres, the effect of which is to place the greater part of the nervous system, but especially such portions of it as minister to the actions resulting from the gratification of the passion, in strict relation to the organs which not only directly concur to this end, but in the development of the future being. The sensual apparatus, in all its variety of modifications, awakens in the mammæ and throughout the animal economy, numerous sympathetic phenomena. The stimulus which its nerves receive, whether at the moment of conception or in the successive stages of gestation, radiates from them in all directions; but particularly in the latter case to the breasts, the bust and the fleshy masses immediately exterior to the pelvis.

CCCLXXXIX. The changes which occur in these organs are to a great extent due to organic sympathy, or, in other words, to the transmission of an influence from the nerves of one region to those of another. Some writers have attempted to show that the sympathetic phenomena manifested under these circumstances, are not to be ascribed to any nervous associations, but to the connexion of the different organs through the medium of blood-vessels. All actions, whatever be their nature, whether mental or bodily, invariably originate in nervous matter. This contains the principle which animates the entire organism. Circulation, absorption, secretion and nutrition are under its immediate controul. That these functions are greatly modified during the process of gestation, is too obvious to require any illustration. The sympathy, however, which they display in relation to the diversified conditions of the uterus, is alone explicable on nervous changes. The animating principle cannot be roused and concentrated to an extraordinary degree in the uterine system, without stimulating proportionably the brain, the spinal marrow and their numerous nerves. A demand is made on these organs for the supply of the nervous agent which is rapidly expended on the fœtus, and the necessity which impels the honoring of the demand, inevitably excites them to more vigorous and comprehensive duties. The extent of their engagements is multiplied in the ratio of the activity of the uterus. Did not a principle, susceptible of these modifications, pervade the nervous system, every local vital action, if such were possible, would cease to be the source of sympathetic phenomena.

CCCXC. Of the intimate connexion between the gums and the mucous membrane of the intestines, and, also, with the whole of the nervous system, we have frequent instances in infancy. The irritation of the gums generally disorders the stomach and bowels. The food is often rejected by the one, and is not allowed to remain to undergo its ordinary changes, in the other. This is regarded as an example of sympathy from the continuity of structure. It is questionable, however, whether it be to the extent which is imagined. In all these cases, the physiologist does not sufficiently consider the constitutional effects produced. The attention must not be restricted to the direct agency of the gums on the intestines. The nerves are undoubtedly the media between the two for the transmission of a disturbing influence. The nervous centres, however, are deeply involved in the existing mischief. The child is proverbially fretful, or in other terms, the brain is exceedingly irritable, and, as a necessary consequence, creates a correspondingly morbid condition of the entire nervous system. All the functions of life are equally affected. The body loses its flesh, and the flesh its usual fulness and firmness; the organs of locomotion feebly obey the will, nor is the will capable of being vigorously exercised; the circulation is quickened, and the blood no longer possesses its usual nutritious properties.

It is under these or similar circumstances, that the swollen or painful state of the gums disorders the functions of the digestive organs. How much of the effect arises from derangement of the nervous system *generally*, or from the original source of the evil implicating particular nerves, it is impossible to say. The predisposition to morbid action, wherever it manifests itself, is largely due to the former.

CCCXCI. It is to the irritation of the gums that a large proportion of the cerebral affections of infancy is to be referred. The impressions it excites are transmitted along the nerves to the brain, until at length unequivocal symptoms of inflammation are produced, which either terminate life abruptly, or lay the foundation of chronic and often incurable mischief. This is an unexceptionable illustration of organic sympathy. The nerves are the only media, in this instance, for the direct conveyance of the disturbing influence to the cerebrum, as well as for the reciprocal action between it and the gums.

CCCXCII. The stomach, in its relations to the animal economy generally, presents an exquisite example of the same kind of sympathy. The food or the stimulants that are taken, when imperatively required, have an instantaneous effect on the functions of life. The feeling of languor or prostration is at once removed. New energies are awakened in every fibre, and a grateful sentiment of pleasurable excitement, which few have experienced to its full extent, is the immediate result. The writer, on this occasion, is describing his own sensations. Some years ago, having abstained, for several months from wine and all stimulants, and being at the same time busily engaged in professional pursuits which made a serious demand on his mental and bodily powers,—a demand beyond the supply of nutrition, was, on returning from a distant visit, seized on the road with a numbness of his hands and lower extremities. The former became white and to appearance dead. Alarmed at these symptoms which gradually increased, he alighted, as soon as he reached the house of a friend, and asked for a glass of wine. The impression it produced is as lively as if it had occurred yesterday. It is not easy, however, to convey to others an adequate idea of it. It can be compared only to a species of electric shock transmitted from the pit of the stomach to every part of the body. He had several attacks of the same kind, within the following ten days, which were generally removed in a few hours by stimulants. It was on the first occasion only that he experienced this peculiar sensation.

CCCXCIII. In this, and all similar instances, it would be absurd to suppose that the stimulant had been absorbed. The delightful feelings which it excited occurred with almost the rapidity of thought. It is to the nerves alone we must look for an explanation of the phenomenon, and, unless we regard them as the channels for the distribution of an animating principle, it is difficult to account for it. It was this principle which the stimulant aroused; and it re-established its former comprehensive relations with the animal economy. There is no fact in the wide range of physiological science that more directly supports this opinion, than the one here stated. It is also a striking illustration of organic sympathy.

The agreeable sensations unquestionably concurred in maintaining the beneficial influence excited. They are not, however, to be viewed as the causes of it, but as effects springing out of the altered cerebral conditions, in the same manner as the modified action of the stomach originates in the functional changes of the nerves. Had the mind, under these circumstances, not been in a state to take cognizance of the impressions, these would, nevertheless, have been communicated to the entire nervous system. As long as the nervous centres have that amount of sensibility essential to the continuance of life, stimulants will give rise to their ordinary organic effects.

CCCXCIV. Another instance of this species of sympathy, is the influence of the mucous membrane on the muscular coat of the stomach, bladder and intestines. Every change in the vital conditions of the former, affects the contractions of the latter, and to a far greater extent than if the agents had been applied directly to it. The functional associations between the two, have been supposed by writers to arise from the same nerves being distributed to both membranes, so that every impression received by the internal coat is imagined to be at once conveyed to the muscular. Whether endowed by the same or different nerves, the structural connexions between the two are clearly of such a nature, that the nervous principle, common to both, cannot be roused in one situation without immediately modifying the action, in another. It must, also, be kept in view, that long anterior to birth the two membranes have reciprocally acted upon each other, and, that the sympathies by which they are distinguished, are gradually developed by the progress of years and the changes in the quantity and quality of the ingesta.

CCCXCV. It is urged by several high physiological authorities, that the same relation exists between the internal membrane of the heart and its muscular fibres. These are said to be excited to contraction from the contact of the blood with the former. As previously remarked, there are strong objections to this opinion. Were this the fact the contractions should instantaneously cease, which they do not, on the withdrawal of the stimulus. They will continue, in some cases, for several hours, and may be strongly revived on the application of warm water to the heart, as well as by mechanical irritation,—circumstances which unequivocally show, that the muscular motions are not wholly due to the impressions made upon the internal membrane.

CCCXCVI. The mucous membrane of the nose and of the entire mouth, readily sympathizes with the altered conditions of the same tissue throughout the alimentary canal. An irritation here, whether from worms, imperfectly digested food or disease, is immediately detected in the structural changes in the former situations, and hence the value of the indications as leading to a knowledge of the source of the evil. The question naturally occurs how does irritation of the stomach and intestines produce these changes? When it has continued some time, and in a form not sufficiently severe to interrupt the ordinary occupations of the individual, the tongue becomes pointed and diminished in volume, its surface is smooth or its papillæ are enlarged and elevated, or the organ may be otherwise modified in its appearance. In this, and many similar cases, an explanation of the effects is to be found in the consideration of two circumstances,—*the state of the nervous system generally, and of the nerves implicated in the original morbid action.* In studying the influence of the former, our remarks will have a reference more or less direct to all maladies which disorder the condition of the mucous membrane of the mouth.

CCCXCVII. In examining the tongue, as a guide in the investigation of disease, we are too apt to regard it in its relations to the digestive apparatus only. The office of every organ, whether of circulation, absorption or secretion, is under the immediate controul of the nervous system; and the effects which arise from its disturbance are manifested by a variety of symptoms. Among these we have the altered volume of the tongue, its polished or coated surface. Its vital functions can be performed only as long as the nervous principle is supplied in its usual amount. Every irritation or morbid process, wherever it exists, will diminish the required current and hence proportionately derange the conditions of the tongue. Whether it be glazed or abundantly coated with fur, will depend not only on the state of the nervous system generally, but on the character of the local irritation. If this be exceedingly aggravated, or occupy a considerable portion of the mucous membrane of the digestive organs, the former result will mostly be observed. If less in degree, the latter. In the one case, the secretory functions of the tongue are nearly altogether arrested; in the other they are continued to a far greater extent. The two express very different constitutional changes. Both are equally evidence of the derangement of the nervous system, and, if their respective symptoms were properly understood, they would furnish light of no mean value towards their correction. They should be analyzed in their relations to such system, and less exclusively in connexion with the imagined local seat of the predominant disease.

CCCXCVIII. Independently of any general affection of the nervous system elucidating the origin of these symptoms, the morbid action of the alimentary canal will influence directly the nerves belonging to the mucous membrane of all the open passages, as the nose, mouth, anus and vagina. It will increase or diminish their several secretions. The nature of the effects will depend on the modifications in the distribution of the nervous fluid. It will be accelerated or retarded in its flow towards these parts, according to the character of the irritation and the condition of the mucous membrane in which the irritation is excited.

Unless the nerves were the media for the transmission of some agent, it is difficult to imagine in what mode such remote changes could be produced. If we regard them as animated by a principle which may be variously altered in its conditions in all organs, according to the state of the vital powers either locally or generally, we are able to form some idea of the manner in which the morbid action of the nerves affects others widely removed from them. And, indeed, without some such basis for our reasoning, it would be equally impossible to attempt to explain the operation of a variety of causes which influence the nervous system at large. These must act on a something which is capable of being generated and dissipated,—a something which constitutes not only the vitality of the nerves, but of every molecule of the bodily structure.

The consideration of the next subject will strongly illustrate the necessity of such a view in the endeavour to account for the phenomena which fall under observation.

CCCXCIX. The affections to which the nerves are liable from cold, wounds and numerous sources of irritation, causing acute pain, paralysis, and occasionally locked-jaw, are explicable only on the existence of a nervous principle. The examination of several of these cases, would exhibit the application of the doctrine to the whole class of such diseases. The first object for investigation, *is the physical condition of the nerves which gives rise to pain.* The sensation is one thing, and the cause of it, another. It is the latter only which belongs to this inquiry. All sensitive nerves have such a relation to the brain that when injured, suffering is the immediate consequence. Their natural sensibility arises from the presence of a nervous agent, and from their connexion with a certain portion of the cerebrum, with which the faculty of consciousness is directly associated. This agent may be either increased or diminished in all such nerves. *The one state invariably aggravates the sensibility: the other destroys it.* Every irritation of the nerves is necessarily accompanied with a local accumulation of the nervous principle, and, at times, to such an extent that a breath of air, or the slightest imaginable touch occasions intollerable pain. The concentration of the principle is equivalent to the creation of a large mass of nervous matter. The diseased nerves have multiplied their relations to the brain,—relations which are in the ratio of their number and magnitude, and of the amount of the animating power which pervades them.

The nerves derive this power from the nervous centres, and the two during every moment of existence reciprocally influence each other; and they are both equally subject to a variety of changes which disturb the normal relations between them. Throughout life they are constantly re-acting on each other according to their more or less excited condition. This view of the cause of the modifications of sensibility has extensive applications to practice, and if appreciated in all its comprehensive bearings, would, in many instances, materially improve the treatment of nervous affections.

cccc. Every step in the investigation of nervous diseases is illustrative of the important laws of sympathetic action. Independently of nerves it cannot exist, nor cannot it be manifested without a nervous agent. Every serious change in the distribution of this power produces effects of which we are usually conscious, and effects which clearly show that the entire nerves of the body are in indissoluble association, so that a disturbance in the functions of one or more modifies the actions of others widely remote from the exciting cause. Not indeed through the influence of sensations, but from changes in the distribution of the nervous energy which are the immediate antecedents to the sensations. It is difficult to select examples, from the multitude which crowd upon the mind in confirmation of the accuracy of this opinion.

The variety of nervous symptoms arising from derangement of the digestive organs, comparatively slight in degree, from their frequency, are, perhaps, the most worthy of notice. On this subject we unfortunately write from extensive personal experience. A trivial deviation from the ordinary rules of diet, especially when the nervous system has been severely taxed by mental pursuits, is often the occasion of the most distressing pains. At one time, affecting the muscles of the thighs and legs, so acutely that, whether at rest or in motion they are not to be borne with composure. At another, with equal poignancy, they attack the muscles of the chest, rendering it somewhat difficult for the professional sufferer to determine whether the malady be purely nervous, disordering the functions of the muscles, or the commencement of formidable pulmonary disease. Or, perhaps, the pains are seated in the loins and are aggravated at every attempt at bodily motion. They not only produce these effects, but for the time an irritability of temper which requires no external causes to ruffle it. The elements abundantly exist within the mind. All these cases are striking illustrations of organic sympathy originating in the irregular distribution of the nervous principle. In these, and many similar instances, the phenomena do not necessarily arise from any direct connexion or anastomoses between the nerves primarily and those secondarily affected. The stomach may disorder the liver, and this the stomach, and either derange other organs or in turn be influenced by them,—effects which cannot arise without implicating in the morbid action the brain and the spinal cord, and it is the changes in the condition of these nervous centres, which to a very great extent, occasion the painful impressions excited. Abnormal relations are established between the numerous nerves and these centres, the nature of which is, *a modification in the distribution of the nervous energy.* The correction of such induced disturbance is frequently a tedious process.

In many cases, the sympathy which is manifested, as between the liver and the shoulder, the bladder and the glans penis, and the hip and the knee, in disease of the former, arises probably altogether from the direct transmission of impressions from the nerves of one organ to those of another, or from direct changes in the condition of the nerves in which the irritation originates.

CCCCI. It sometimes happens that a slight wound causes a perfect rigidity of the muscles, as in tetanus and locked-jaw. The nature of the malady has hitherto been considered as inexplicable, and certainly there is no hypothesis on which it is rationally accounted for. It can scarcely be ascribed to inflammation of the spinal marrow or nerves, or of their investing membranes. Effects, regarded as evidence of it, may often be found after death, but such inevitably flow from the serious local derangement of the circulatory system consequent on this formidable disease. The symptoms which accompany it are not those which characterize acute inflammation of nervous matter. The pulse is often remarkably tranquil, the mental powers clear and undisturbed; in fact there is the entire absence of all those indications which are imagined to authorize the employment of strong and repeated depletory measures.

The affection originates in a morbid state of the nerves conjoined with a peculiar susceptibility of the nervous or animal system generally, and it readily extends from one series of nerves to another, until ultimately it gives rise to a permanent spasm of the muscles, as in those of the lower jaw and adjacent parts, in trismus. To say that the phenomena arise from the sympathy existing between the cut or lacerated nerves, and the cord or nerves of the organs subsequently involved, does not present a just view of their nature. The distressing effects do not occur immediately on the injury inflicted, but mostly after many days, and frequently when the wound is healed,—a circumstance not unimportant to examine.

When we consider that the sensibility of nerves may be greatly heightened from whatever creates an undue accumulation of the nervous principle in them, and is in fact proportionate to it; it is rational to suppose that the motory nerves may be similarly influenced, so that the withdrawal or concentration of the nervous agent may be the direct cause of the fixed rigidity of the muscles. An extraordinary change is produced in the condition of the nerves from the unhealthy character of the wound, and though not manifested for many days, it is gradually communicated from the source of the irritation to the spinal cord and the nerves regulating the action of numerous voluntary organs. Were they not endowed with a principle susceptible of these modifications, it would be in vain to attempt an explanation of increased or diminished sensibility, or of corresponding alterations in the properties of the nerves of motion. When the principle is thus seriously disturbed in its distribution, it is difficult to re-establish its normal conditions, and hence the generally fatal character of the disease. Every imaginable method has been had recourse to in its treatment, but with very limited success; nor is it strange when we reflect that the measures employed were suggested by no enlightened views concerning its nature.

That the symptoms should frequently occur after the wound is healed, is, perhaps, rather to be anticipated, in certain peculiar states of the animal system, than regarded as remarkable. As long as it remains open, there is an easy exit, not simply for the grosser matters, but for those which elude the scrutiny of the senses, the retention of which may possibly be the cause of the affection. The restoration of the part to health closes the passage for their escape, and having no channel by which to relieve themselves, they are thrown upon certain portions of the nervous system which, from the previous irritation communicated to them, or from other circumstances, are peculiarly disposed to sympathize in the existing morbid action.

CCCCII. The disease frequently arises independently of any wound or surgical operation, by which nerves are divided or otherwise injured, as in infants from worms, or acrimonious substances irritating the sensitive mucous membrane of the stomach or bowels; and, also, particularly in warm climates, from chilness and damp connected with the sudden vicissitudes of heat and cold. The consideration of the mode in which these causes act, is in direct support of the reasoning which is here advanced. They affect directly the condition of the nerves, or in other words, disorder the distribution of the nervous principle, and to such an extent as to give rise almost immediately to the symptoms of the malady. Were this the place for an elaborate investigation of it, it would be by no means difficult to show, that the high and prevailing temperature of certain regions, where the affection is of frequent occurrence, produces those changes in the nervous system which strongly approximate to those of the infant,—changes the study of which would go far to demonstrate the general correctness of the views contained in these pages.

CCCCIII. In cases of direct injury of the nerves, the term sympathy, in its ordinary acceptation, does not convey a clear notion of the nature of the phenomena. A local irritation is set up and gradually extends from the nerves primarily affected to others, every step of which modifies the conditions and relations of the nervous fluid, until, at last, the mischief induced is incompatible with the regular performance of the functions of life, and hence the permanent rigidity of the voluntary muscles, as in trismus and tetanus.

CCCCIV. There are few subjects of greater interest, in a practical point of view, than the influence of diseased states of the skin on the different organs of the animal economy; and none, if studied in a truly philosophical spirit that more strongly confirm the justness of the physiological doctrines developed, not only in reference to the principles of sympathetic action, but the widely pervading laws which preside over all vital operations. We shall here, however, only briefly allude to them in their connexion with what are designated sympathetic phenomena. In the next chapter, we shall enter more fully into the analysis of those nervous conditions in which these and other phenomena originate.

The intimate relations existing between the cutaneous surface and the whole of the mucous membrane, as well as with all secretory organs, are well known, and have been treated at large by writers. The field, nevertheless, is far from being exhausted or unfruitful in valuable truths, if cultivated with the attention it deserves. We shall endeavour to awaken an interest in one small portion of it, though not in a degree adequate to its importance.

CCCCV. The effects which flow from the modified action of the skin in any region, and often from the altered functions of a space exceedingly limited, are not to be traced, properly speaking, to any *direct* connexion between the organs primarily and those secondarily affected, to a similarity of structure, to the exercise of analogous offices, or, indeed, to a *reflex* action of one class of nerves upon another: by which term is meant an influence directly conveyed from the one to the other remotely situated. It is, in fact, such a change in the properties of nervous matter, that the principle with which it is endowed is so disturbed in its ordinary relations by increased or diminished vital processes, that the amount which is distributed to, or remains as the capital of the numerous organs, will vary with these circumstances. It is on this view only that it is possible to offer a rational explanation of the origin of a variety of diseases immediately springing out of the locally altered conditions of the skin. How often has it been observed, (and such instances have fallen under our own notice,) that the curing of an extremely circumscribed eruption, whether on the face or elsewhere, or the healing of a small ulcer of long standing, has almost, at once, given rise to hemoptysis—to the return of hæmorrhoids—to the copious discharge of blood from the anus—to apoplexy—to cerebral affections in advanced life, marked by the loss of memory and the obliteration of the mental faculties—to paralysis,—epilepsy and a long catalogue of evils. Is it reasonable to imagine that an ulcer, often not larger than a bean, or an eruption exceedingly limited, is accompanied with such a state of the capillaries directly interested, that the excess of blood they possess,—set at liberty on the removal of the disease, is the occasion of the morbid effects which follow? Can a small quantity so detained, when suddenly thrown upon the animal system, possibly be fraught with such a power? The idea would be an absurdity. These phenomena are usually accounted for on the sympathy existing between the skin and the various structures in which a morbid action is induced. The term, however, explains nothing; nor has the investigation of the cause, in the hands of physiologists, given rise to any exact views on the subject. What extensive relations can a mere fraction of the cutaneous surface have with the brain, the heart, the lungs, and the intestines, that a modification of its functions, nay even its restoration to a healthy state, should so seriously injure these more important organs as frequently to cause death? The solution of the question is not to be found in the direct connexion between the few nervous filaments implicated in the original source of the irritation, and the nerves involved in the subsequent and remote disease. Nor will it be urged that sensation takes any part in the production of these effects, or that the brain in any degree co-operates. The phenomena are explicable on one consideration only.

CCCCVI. The nervous system, in health, and in every local and constitutional disease, has a fixed or permanent character, and has likewise its established relations with every part of the animal economy, which, whilst they are harmoniously, are often exceedingly delicately poised. An ulcer, an eruption, or any habitual discharge, is in perfect accordance with such prevailing relations, and the action which characterizes each of the vital processes, keeps in subjection an amount of the nervous principle proportionate to the existing irritation,—an amount, however, which is not to be accurately judged from the small surface obviously occupied by the disease. This will throw little light on the extent of its concentration. The obstinate ulcer or eruption, wherever situated, is a point towards which the nervous energy flows, and from which radiates an influence far beyond the source of the irritation, so that the quantity of the nervous power determined in such direction very far exceeds that which is engaged in the apparently limited morbid action. This view cannot be too strongly impressed upon the mind. When the irritation is suddenly removed, the established relations of the whole nervous system are disturbed. The finely adjusted balance of the whole is broken. A portion of the nervous principle is liberated from its previous local operations, and to what part of the body or structure it will flow, or by what symptoms it will be manifested, will depend on the susceptibility of the numerous organs constituting the animal economy.

It must further be taken into account in considering the agency of the nervous power, that it is creative in its nature. It does not, like the blood, contain the elements of nutrition, but it is that which gives to these elements their vitality. Hence the potency of its influence, when distributed in undue quantity to any of the structures, in producing effects incompatible with the well being of the functions of life. It is, therefore, evident, that the sympathetic phenomena developed under these circumstances, are not to be ascribed to any direct connexion among the several nerves, primarily and secondarily involved, in the sense in which it is generally understood, nor to a reflex action of the nerves as explained by physiologists, but simply to a modification in the condition of the animating agent of the nervous system.

CCCCVII. It is on these views only that it is possible to offer a rational hypothesis on the action of a variety of agents applied to the skin in the treatment of internal diseases, whether acute or chronic in their nature. It is not to be implied from the arguments advanced in support of the influence of this all-important power, that the changes in the conditions of the blood, both in its quality and distribution, in all these cases, are not to be regarded as co-operating with the induced nervous changes in the curative process. Such a conclusion would be most unphilosophical. The modifications in the circulating fluid, however, are effects springing out of impressions previously made upon the nervous system, and consequently, in this place, do not fall immediately under our consideration. They constitute an independent branch of inquiry, in interest and practical value scarcely inferior to the one engaging our attention.

CCCCVIII. The application of a small blister to a part of the body remote from the seat of the malady, and retained only so long as to produce irritation of the cutis, will frequently arrest inflammatory action, and correct a variety of morbid symptoms. In what manner is the beneficial result to be accounted for? Clearly not on the concentration, in a healthy structure, of an exceedingly small amount of blood withdrawn from the distant organ affected. Such an idea cannot for a moment be entertained. The local irritation is a new action set up at the expense of the nervous principle, and the accumulation of it here is sufficient to modify the diseased process in whatever region it exists.

CCCCIX. The good unquestionably effected by the persevering measures of the hydropathists, is chiefly to be traced to the altered states of the nervous system in its relations to the cutaneous surface. The innumerable nerves distributed to it are awakened to new energies, to duties which they have long ceased to perform efficiently; and let it be kept in mind that every step of the induced changes is a step in which the entire animal economy sympathizes. So far from the cures accomplished by such treatment being extraordinary, or too marvellous to be implicitly received, they are the natural consequences of the measures enforced and are easy of explanation. The medical profession generally are either too strongly prepossessed in favour of their own opinions, whether adopted or resulting from their own experience, or too superficially acquainted with the laws of vital action, to appreciate, at their just value, novel and often comprehensive modes of treatment. Whatever produces a good effect is worthy of investigation, and whether recommended by the scientific or illiterate has a claim on our attention. He who is satisfied with his acquirements or inflated with what he knows, has much to learn.

CCCCX. The success of the hydropathic treatment is altogether attributable to a modification of the laws of organic sympathy, the analysis of which will satisfactorily point out the mode in which it is effected. It must be admitted by the dispassionate inquirer, that a variety of maladies are frequently cured by it, such as dyspepsia in all its multifarious forms, rheumatism, gout, epilepsy, hysteria and severe nervous affections, obstinate constipation, enlarged and otherwise diseased organs, cutaneous eruptions and distressing disorders of the uterine system. These results arise from the impressions made upon the superficial nerves. The action induced in them modifies the vital properties of every tissue. The increased amount of the nervous energy drawn to the surface invigorates the external capillaries, and so far gives a new direction to the circulating fluid. Congested organs are thus gradually relieved of their excess of blood, the beneficial effect of which from its initial step, is not only in the same proportion improving its qualites, but enabling the various structures to recover their natural tone and function.

CCCCXI. There are no remedial measures at all comparable, either in their extent or efficiency, to the hydropathic treatment in numerous diseases. We are not personally interested in its success. The expression of our opinion is partly the result of the consideration of the mode in which it operates. The allusion to it, in this place, belongs to the analysis of organic sympathy, and it is an admirable illustration of the truth of the physiological doctrines on which this principle is explained. Did it fall within the scope of this inquiry to discuss the subject at length, it might be shown to have far higher claims to impartial investigation than it is admitted to possess.

CCCCXII. Every disease displays the influence of organic sympathy. It is to this that a variety of symptoms, whether acute or chronic, is to be traced. The changes in the properties of the blood, and all structural alterations, are the consequences of it. Were the laws, according to which it acts generally understood, juster views of the origin and nature of morbid action would be entertained. At one time this is greatly excited, at another, it is equally depressed. It varies in different organs, and in the constitutional disturbance to which it gives rise, though each may be the seat of acute inflammation. These diversities are alone explicable on the modifications of organic sympathy, the consideration of which, in its relations to disease, has a practical importance which can scarcely be over estimated.

CCCCXIII. Physiologists, in treating of sympathy, frequently allude to the depression of the heart's action in inflammation of the stomach or intestines. They give, however, no explanation of the phenomenon. Every morbid process will influence the functions of the heart in proportion to the stimulus it directly imparts to the nervous system, or to particular nerves co-operating in the chemical changes of the blood in the lungs, and the constitutional derangement will be in the ratio of these circumstances.

The stomach and the intestines are, perhaps, the most richly endowed with nerves of any region of the body, distributed as they are over a large surface, the whole of which usually becomes implicated in every acute affection of these organs. The amount of the nerves and the extent of the surface involved, are conditions which will elucidate the character of the sympathetic influence developed. When the organs are attacked by acute inflammation, the nerves directly interested necessarily draw towards them the nervous energy from contiguous as well as remote regions, and hence it is that the heart generally becomes weakened in its action. The highly inflammatory mucous surface invariably becomes exceedingly congested, and the blood, as well as the nervous principle, flow in increased quantity in this particular direction. Were the sympathetic relations between the mucous membrane and the animal system generally less extensive, consequently less calculated to affect the current of the nervous fluid, *re-action*, on which the constitutional symptoms depend, would be far more likely to occur. It is on this view, and this only, that the vast influence which every disordered action of the stomach exerts on the functions of life, animal and organic, can possibly be philosophically accounted for. The transitory derangment of its large nervous surface disturbs the mental operations, depresses the spirits, and renders the mind unequal to intellectual pursuits. The same large surface when suffering from acute disease, from the existence of the same comprehensive relations, produces an effect too aggravated in its nature to cause re-action, without which the heart contracts feebly as indicated by the small thread-like pulse.

CCCCXIV. In acute inflammation of the lungs we have other symptoms. The circulatory system is greatly excited. The blood is propelled in augmented force and in increased quantity to every part of the body, possessing also additional stimulating properties. Here we have a class of phenomena widely different from the former. And why? The new sympathies awakened are not difficult to explain. The nerves are first affected by that condition which occasions acute inflammation of the lungs, and they have not, in this situation, the same extensive relations with the animal economy as in the stomach. If excited to increased action, the effect is to arouse the energies of other nerves associated in the process of respiration, and the influence gradually extends increasing at every step the chemical changes of the blood, hence its more vital properties and the greater force with which it is propelled. The accelerated and invigorated contractions of the heart, arteries and capillaries, are only to a slight degree, if at all, due to the stimulus of the nerves of the lungs directly imparted to those of the circulatory apparatus. They are to be ascribed to the altered qualities of the blood which permeates and modifies the action of every tissue.

CCCCXV. There is one other illustration of organic sympathy developed by disease demanding particular notice, as it presents phenomena differing in many respects from those accompanying the foregoing cases. We allude to acute rheumatism which is essentially nervous in its nature, and the mode of treatment, and here we speak from extensive experience. The measures which are at once the most efficient and prompt in the relief they afford, are such as influence immediately the nervous system independently of the abstraction of blood. No other disease gives rise to a wider range of sympathies. Acute pain, aggravated by the slightest bodily motion, a quick, full and bounding pulse, and the blood possessing in the highest degree those properties regarded as indicative of inflammation, are its leading symptoms. Here the nerves of the part affected, often occupying an extremely limited space, communicate to others and the nervous system generally, a stimulus which disturbs the whole of the functions of life. The disease being purely nervous in its origin and seated in structures which become peculiarly sensitive, it is easy to explain the constitutional derangement by which it is characterized, as well as the efficacy of remedies which act directly on the nervous system.

CCCCXVI. The intermittent action which distinguishes the functions of most organs, whether mental or bodily, is a striking illustration of organic sympathy from a modification in the distribution of the nervous principle. The digestive apparatus, the muscles of voluntary motion, and the generative system, are familiar instances of the kind. The nerves of each have their periods of repose and activity. Is it reasonable to suppose, that in both conditions they have the same amount of that agent in virtue of which they stimulate the structures with which they are associated? The idea would be an absurdity, and equally so to contend that they are endowed with no such power.

CCCCXVII. The consideration of the temperaments, had we space to pursue the inquiry, would furnish abundant facts in confirmation of the views which elucidate the subject of organic sympathy. Every constitution has its peculiar vital conditions common to the numerous tissues. In one they are characterized by inactivity,—by the want of tone; in another they are overflowing with the energies of life; and between the extremes we have every possible gradation. The diversities are owing to corresponding differences in the properties of nervous matter. The quantity of the stimulus by which it is animated is unlike in each constitution, and hence the extraordinary dissimilarity in the vital endowments.

CCCCXVIII. With these remarks we must close the analysis of sympathetic phenomena. The undertaking is one of no ordinary difficulty, either from its extent or the nature of the vital actions which have occupied our attention; nor is it simply interesting to the physiologist. Every step of the inquiry has an intimate and practical relation to the vast field of medical science, as well as to the pursuits and speculations of the metaphysician. If our efforts have not been successful in the establishment of unquestionable truths, the ground has, nevertheless, been broken in new directions, and numerous facts previously not studied or imperfectly appreciated, have been brought into prominent notice. If we have erred in our views and arguments, the correction of our errors cannot fail to enlarge the boundaries of knowledge.

CHAPTER III.

THE NATURE OF THE RELATIONS BETWEEN DISEASES ATTACKING THE SAME PERSON AT DIFFERENT AND OFTEN REMOTE PERIODS.

CCCCXIX. The subject we propose briefly to discuss is of great practical importance, and though it has not been elaborately studied by the medical inquirer, it has nevertheless been frequently brought under notice. The disappearance of a disease, regarded as somewhat constitutional, and the succession of another, from natural changes in the condition of the vital powers, are phenomena with which every practitioner is more or less familiar. The suppression of gout has often given rise to mania or epilepsy; and the occurrence of the latter has likewise thoroughly corrected the tendency to paroxysms of gout; and the failure in the regular return of this distressing affection has repeatedly been followed by a variety of morbid symptoms, such as difficulty of breathing, cough, dropsy, paralysis, loss of sensation, and other disorders of the nervous system. The cessation of hæmorrhoids in one who has long been subject to them, whether from medical treatment or independently of it, is occasionally succeeded by these and other diseases, as structural alterations of the heart or its vessels, or of the abdominal viscera.

Such effects are of common occurrence, and many others might be added to the foregoing list. According to the doctrine of the accurate and judicious Parry,* they are explicable on the increased determination or momentum of blood,—a doctrine to which he traces the origin of diseases generally. We shall subsequently examine its claims to attention.

CCCCXX. Every season of life has its distinctive organic conditions, which, if understood, would elucidate the predisposition to certain affections, as well as the morbid phenomena occasionally resulting from the spontaneous disappearance or modification of them. In infancy and childhood there are two large surfaces, the skin and the mucous membrane of the respiratory and digestive apparatus, characterized by the extreme activity of their functions, and hence their tendency to acute inflammatory action. The exanthemata or eruptive fevers, are evidence of the activity of the *external* surface; as apthæ, pertussis and croup, are of the *internal:* but independently of these unerring and natural indications of the vigour of the vital operations, the numerous disorders to which these surfaces are liable,—their extraordinary susceptibility of derangement, are strikingly illustrative of the correctness of these views. At no subsequent period of existence is the nervous system equally fraught with vital properties; it is, however, an affluence in reference to functions engaged in the maturing of the animal frame. The demands in the direction of these organic necessities, may be considered as outlets for the exuberant nervous principle created. The nervous system has not a predominance, except in such relations, and hence in early life nervous symptoms are rare, save such as arise from direct irritation of the gums and alimentary canal. The readiness with which these are produced, is evidence of the prevailing activity of this system.

---

* Elements of Pathology and Therapeutics, p. 297.

CCCCXXI. Puberty in both sexes is the commencement of a new sphere of mental and vital action. The nutritive functions have, in a great measure, accomplished the end which nature had assigned to them, *viz.*, the development of the bodily powers. The invigorating current of the animating principle enters upon fresh duties, widely different from its previous engagements, the consideration of which is essential to a just understanding of the variety of nervous phenomena resulting,—to an appreciation of the general cause to which they are to be referred.

The generative organs are roused into activity, and the changes induced in them are accompanied with corresponding modifications in the functions of the great nervous centres. New tastes and passions are displayed. The restless muscular motions of childhood and spirits as buoyant as they are inexhaustible, give place, at least, in the one sex, to much less bodily exertion, to timidity, sedateness and reflection, beneath the surface of which, however, lie the stirring and disturbing elements of existence, hopes and anxieties unexpressed and desires ungratified. It is at this season of life that nervous affections peculiarly manifest themselves, especially in the female, such as hysteria, epilepsy, spasms, fainting, palpitation of the heart, mania, and various forms of cerebral derangement. The nervous system is active, but it is in reference to organs which largely minister to the passions; and consequently the predominating energy by which it is distinguished, is, strictly speaking, in relation to itself. The abounding nervous principle is not, as at an earlier period, expended on the nutritive processes occupied in building up new matter; nor does it find a vent in the playful and ceaseless movements of the limbs; but on the contrary it is to be regarded as a certain capital only partially employed, and in directions which tend to maintain it in lively operation. It awakens new sensibilities, and imparts intensity to the feelings as well as a wider sway over the vital functions.

CCCCXXII. In contemplating the nervous system, under these circumstances, it is impossible not to perceive that the condition induced is one which clearly indicates the presence of a pervading energy, increased in its amount and modified in its relations with the development of the animal frame; but especially is it to be viewed as a power in association with organs prepared and waiting to be called into action,—organs as yet unexercised, and hence existing as fruitful sources of irritation, and of an influence which is to be traced to the concentration of the nervous principle. The absence of the demands for it in the legitimate indulgence of the passions, necessarily leaves it in undue quantity in the nervous system, destitute of its appropriate outlets; and to this circumstance is to be ascribed the numerous nervous phenomena which result.

CCCCXXIII. These remarks are simply introductory to the examination of another condition of the nervous system belonging to the adult period of life. It offers considerations widely different from those we have studied. It is not in relation to the nutritive processes engaged in the completion of the bodily organization; nor is it in relation to particular organs not yet called into vigorous exercise. The condition, whatever may be its character, constitutes largely the temperament of the individual.

Whether the tendencies be intellectual or sensual, the nervous system possesses an established influence in harmony with the existing necessities, and every organic action suddenly induced or suppressed, will be liable to modify the vital functions generally, and at times to a serious extent. In health, and in every disorder somewhat constitutional from its long persistence, as cough, dyspnœa, headache, diarrhœa, constipation, or any habitual discharge, whether periodical or otherwise, the nervous system has acquired comparatively fixed relations to all parts of the body, and their disturbance, even in the curative efforts of nature, will occasionally give rise to fatal consequences. The cause is not difficult to explain. Every vital operation necessarily implies the employment of a certain amount of the animating principle, which will be diverted from its accustomed channels by every new action set up. These changes constitute the phenomena of metastasis. The morbid local process characterizing gout or rheumatism, is transferred to the heart; or that of hæmorrhoids to some of the internal organs producing hæmorrhage; or to the brain, and is followed by paralysis; or that which is the cause of a variety of nervous affections, unexpectedly terminates in rheumatism and the previous symptoms entirely disappear.

CCCCXXIV. As all vital actions, whether natural or morbid, are nervous, or in other terms, are to be traced to the influence of the nervous system on the grosser particles of matter, to whatever end they may be appropriated, it is easy to account for the occurrence of particular diseases at the different periods of life. They inevitably spring out of the prevailing conditions of this system. The same view will also suggest a rational hypothesis concerning the tendency, in some constitutions, for one affection to be immediately, or at no distant period, replaced by another.

CCCCXXV. It will not be doubted that every individual is born with certain definite organic peculiarities though occasionally difficult to recognize. In one there is a predisposition to gout, in another to insanity, in a third to rheumatism, and through an extended series a susceptibility is manifested to some particular morbid action. The cause of these diversified phenomena is to be referred to the prevailing character of the nervous system. It must not be imagined from these remarks, that we leave out of consideration or regard as matters of no importance, the extraordinary differences, in all these cases, in the nature of the solids and fluids which enter into the composition of the body. They equally demand the attention of the enlightened physician; but at the same time it must be steadily kept in mind, that how various or striking so ever they may be, they are simply effects originating in the innate properties of the nervous system. They are unexceptionable evidence of their quality. The mirror does not more faithfully give back the form of the figure, than the state of the solids and fluids pourtrays the existing amount of nervous energy. And every improvement effected in them, whether from exercise, diet or medicine, is primarily a modification in the condition of the nervous system.

CCCCXXVI. All diseases may be divided into two great classes; the one characterized by increased the other by diminished action: and the constitutional predisposition to either, will be according to the natural or acquired vital properties of the nervous system. It is only, as a general rule, where the activity of this system predominates, that we observe the disappearance of a malady, as gout, rheumatism, hæmorrhoids, or any other local disorder, to be almost instantaneously succeeded by some other affection, often of a more serious character. The curing of indolent ulcers, or the dispersion of tumours in a scrofulous habit, is rarely immediately followed by a new form of structural derangement, nature not, as in other instances, imperatively demanding an outlet for the powers previously accumulated in a particular region. And why? Because the nervous system, in all such constitutions, is *under* the requirements of vigorous health. It does not possess a sufficient quantity of the animating principle to excite prominent reaction or disturbance in any other part of the body.

CCCCXXVII. In further corroboration of these views it may be observed, that where the constitution is wanting in tone or nervous energy, as in the scrofulous, the disease which is cured, if succeeded by another, it is mostly after the lapse of considerable time, and that which occurs usually presents the same general symptoms,—all indicative of feeble vital action, and displaying a tendency to the same species of disorganization. Whereas in the constitution distinguished by the activity of the nervous system, the disappearance of an obstinate affection will often be *immediately* followed by another widely different in its manifestations. The sudden dispersion of gout from the ball of the great toe, is sometimes fatal from the disease attacking the heart, or mania, paralysis, gastritis, enteritis, or loss of sensibility may be the result. And the same may be said of the cessation of hæmorrhoids, or of any periodical hæmorrhage, of epilepsy, rheumatism, cutaneous eruptions, or of any fixed or frequently recurring pain. These are striking and important peculiarities, and in a practical point of view exceedingly worthy of examination.

CCCCXXVIII. It is laid down as an indisputable principle by Parry, and the same view is advocated by others, that in all those cases in which a disease of long standing is displaced by another, as gout by epilepsy, or epilepsy by gout, or the latter by mania; or asthma or dropsy consequent on the disappearance of rheumatism or of any other affection, that *the cause is to be traced to "the increased determination or momentum of blood" to the parts influenced.* In this opinion we do not concur, and it may be shown to be untenable on physiological considerations. That the blood is frequently determined to various organs will not for a moment be doubted; but it is under circumstances very different from those which elucidate the origin of the morbid phenomena in question. The distinction between the two has not been clearly pointed out by any writer, and yet it is essentially necessary in this inquiry. The blood may leave one organ or class of organs and accumulate in others, as follows:

I. By a change in the position of the body.

II. By a weakened state of the vessels in consequence of which they have not the power to urge forward the blood at the rate they receive it.

III. By the application of cold to the surface of the body.

IV. By depressing passions, or by whatever weakens either directly or indirectly the action of the heart.

V. By whatever impedes the return of the venous blood.

These are the different modes in which the circulation may be disturbed leading to the accumulation of blood and the production of numerous diseases. They will not, however, explain why a morbid action should occur from the non-appearance of a disease to which the system has long been periodically subject.

CCCCXXIX. We will proceed to analyze some of the cases alluded to by Parry, and attempt to show that these, and all others of a similar character, are inexplicable on his own principle. "In one patient," he observes, "the succession, at somewhat remote periods, was gout, mania, and, at last, fatal epilepsy. In several instances there were fits of epilepsy, wholly superseded by gout." *

Is it to be imagined that, in all these instances, there is an amount of blood exceedingly minute in quantity, which the animal system cannot properly dispose of,—a quantity that at one time flows to the great toe and occasion gout; at another, directs its course to the brain and gives rise to mania or epilepsy? This is clearly his argument. The blood does not select these organs for its temporary or periodical occupation. ITS CONCENTRATION IN EITHER IS INVARIABLY THE EFFECT OF A PRE-EXISTING MORBID CONDITION,—A CONDITION WHICH ORIGINATES IN AND BELONGS TO NERVOUS MATTER. The

---

* Opus cit. p. 303.

blood flows where the action is increased as a consequence and not as a cause.

The heart has no direct influence in these local determinations, nor have the arteries independently of a nervous power appropriating the nutritive elements they convey. The toes and the fingers are frequently inflamed, their vessels congested, and yet we have no gout nor any symptoms approximating to it : so the cerebral circulation is often seriously modified without exciting either epilepsy or mania. When gout suddenly quits the great toe and attacks the heart, stomach, intestines, or brain, is it possible to conceive that the small quantity of blood seated in the organs primarily implicated, on being transmitted to any of the latter, occasions the fatal results which follow ? Is the circulation in these organs so nicely balanced that the slightest interference with it causes death ? The vessels of all parts of the body are capable of adapting themselves to a variety of conditions without disturbing materially the functions of life.

ccccxxx. The acute pain which characterizes gout, when the toe is only just suffused with a blush, is unexceptionable evidence of the truth of these views. From the initial development of the affection throughout its subsequent stages, it is purely nervous in its nature, and is most successfully treated by those measures which influence directly the properties of the nervous system. The marvellous sensibility which is concentrated in the organ, will be admitted as proving an altered state of the nerves bearing indeed no ratio to the congestion of blood. It precedes such effect. The concretions formed in the joints of the toes and fingers, are chiefly to be referred to a modification of nervous action. The increase in the amount of the animating principle in the nerves proportionately augments and deranges the local vital processes, and the particular products evolved are to a certain extent illustrations of this influence. "It is a remarkable fact" observes Mason Good, "hitherto indeed but little dwelt upon, and altogether *unaccounted for*, that as the system advances in years and debility, and every other secretion progressively fails, that of calcareous earth seems to increase. Hence the bones of aged persons are more fragile and apt to break upon slight concussions; and the arteries and various other parts become ossified or loaded with nodules of lime stone; and where a powerful sympathy exists between the kidneys and the stomach, and either of these is in an infirm state, we have a larger deposit of the same material in the kidneys or the bladder. A similar increase of calcareous earth takes place in the weakness of chronic gout."* The same general explanation applies to all these cases. There is, nevertheless, a certain striking difference between the conditions of the system in the aged, and those of the gouty constitution. In the former, there is a gradual diminution of the nervous energy, and from the bodily inactivity accompanying advanced years, the circulation in the muscles and the bones is necessarily greatly decreased, so that in addition to the diminution of such nervous power, there are other causes accounting for the limited vital processes carried on in the bones; and consequently the earthy matter deposited in other situations, will in part arise from them, as well as from their inability to take up and appropriate the elements conveyed to them by the blood.

---

* The Study of Medicine. Vol. II, p. 512.

In gout the same causes are in operation, but the calcareous earth deposited in the smaller joints, is determined to such localities from the previous inordinate nervous action existing in them. The earthy matters, either generated in undue quantity, or, from the state of the system, unemployed in their legitimate directions, must have outlets, and the situation and nature of these will depend on the predisposition of different organs,—a predisposition probably to be traced to their exhausted or debilitated condition.

CCCCXXXI. It is not our business, however, in this place, to discuss, at length, the pathology of gout. A more fitting opportunity will hereafter occur. The study of its leading characteristics is, nevertheless, essentially connected with the present inquiry, and will tend to explain the origin and nature of a large class of morbid phenomena. It is peculiarly valuable in this point of view. Previous to the local development of the disease, it has in many cases its premonitory symptoms with which the sufferer and his immediate attendants are familiar. The digestive organs are disordered, the spirits are unequal, the temper is exceedingly irritable, occasional spasms supervene, and the individual is conscious from a variety of sensations, that these are the shadows which coming events cast before. What do the symptoms indicate, or what inference naturally flows from them? Are we to suppose that a small quantity of blood seeking an outlet, is oppressing the powers of life? Bleeding, whether general or local, seldom arrests the impending attack, nor when present in all its virulence, is it often removed by it.

The affection is not to be traced to any conditions of the circulatory apparatus, to the fulness of the vessels, or to any specific changes in the qualities of the blood, though this is unquestionably modified in its nature, but to the derangement of the nervous system. The principle by which it is pervaded is either unduly accumulated, or irregular in its distribution, and it is this, unsettled and wandering, which excites the multitude of premonitory phenomena. Figuratively speaking, it is embarassed in the choice of a locality.

CCCCXXXII. There are other considerations which go far to prove that gout originates in a peculiar state of the nervous system. The application of leeches to the affected organ, as the ball of the great toe, for example, is admitted by the highest authotities to be a doubtful remedy. It is often instantaneously succeeded by metastasis to the corresponding toe of the other limb. If the cause of the disease existed in the blood, or in a congested condition of the vessels implicated, the outlet which is thus established for the escape of morbid humours, as well as for the removal of local distention, ought to be accompanied with the happiest results. The benefit, however, is rather the exception than the rule; and the same may be observed of general depletion, and almost equally of purgatives, by which the volume of the blood is greatly diminished. These and numerous other facts clearly show, that the disease is not subject to the ordinary laws of inflammation, nor does it modify the condition of the structure which it occupies, either in degree or kind, as the inflammatory process. It is especially a nervous affection, and not having hitherto been studied in this light, but regarded as inflammatory, and imagined to depend on some peculiar state of the blood or digestive organs, accounts for the exhaustless list of internal agents, and external modes of practice which have been, and continue to be employed in its treatment. This has been a rich field for the empiric, and we are bound to acknowledge, that his remedies have frequently been as successful as those of the highly educated physician. Neither has had any clearly defined principles to guide him, in reference either to the nature of the affection or the actions of the medicines prescribed. In confirmation of these remarks, a distinguished authority asks: "Is the gout a local or a constitutional affection? Is it a spasm or a poison? Is its course beneficial or mischievous? Should its *inflammation* be encouraged or counteracted? Is it to be concentrated or repelled? Is it to be treated with cordials or evacuants? With cold or with heat? With a phlogistic or an anti-phlogistic regimen? No sets of questions can be more repugnant to each other than these are; and yet there is not one of them but we may obtain an answer to, either in the negative or in the affirmative, by applying to different practitioners for this purpose." And he further observes, "the moment we enter upon the field of its PROXIMATE CAUSE, we are bewildered in a hopeless labyrinth, without a thread to guide our entangled footsteps amidst the growing darkness."*

CCCCXXXIII. The comparative regularity with which gout seizes on the ball of the great toe, toes or fingers, leaving untouched the larger joints, is in direct confirmation of its nervous character. It is stated by Sir Charles Scudamere, that in 198 cases, the great toe of one foot only was attacked in 130; and, that in those in whom it is hereditary, the great toe is almost always first affected. We are not aware that any writer has attempted to explain the extraordinary preference of the disease to these parts,—the certainty with which it fixes on one or more of them. The speculations which have hitherto prevailed concerning its nature could scarcely suggest a probable hypothesis; indeed, had they consistently been applied in the endeavour to solve the phenomenon, these particular organs would have appeared the least likely to be the seat of the distressing malady. If it be referrible to any condition of the blood, to peccant humours, or the presence in undue degree of any acid, there are natural outlets—outlets on an immense scale, such as the whole class of the secretory organs both within and on the surface of the body, which we should expect to be first disordered; and it would be reasonable to anticipate that if the skin or the kidneys were powerfully excited, the offending matter would be expelled and health would be the immediate result. The skin, at the commencement of the affection or during its course, is frequently suffused with copious perspirations, and the urine almost invariably deposits a considerable sediment; and yet the disease attacks with unerring truthfulness its favourite organs and ruthlessly maintains its occupation.

---

* Mason Good, M.D., Opus. cit., Vol. II., p. 503.

CCCCXXXIV. The almost unvarying tendency of gout to fix on the smaller joints, is to be traced to conditions peculiar to them in reference both to the nervous and circulatory systems, but especially to the former. They are organs necessarily endowed with a high degree of sensibility, to an extent far superior to the larger joints. The functions they perform require a greater delicacy of touch, a finer sense for appreciating the size and presence of external objects, and hence they are most abundantly supplied with nerves.

This is one of the important conditions to be kept in mind in studying the causes of the extreme susceptibility of these organs. The next condition is *peculiar* to them. They have not only an extraordinary amount of nerves establishing wide and intimate relations with the nervous system generally; but these nerves are likewise the farthest removed from the great nervous centres, the sources whence they derive the power in virtue of which they execute their various offices. It is with the nerves, as with the capillaries, the greater the distance of the one from the brain and spinal marrow, and that of the other from the heart, the more feeble is the action of both, and the more liable they are to be depressed by external as well as internal circumstances. They are consequently organs possessing NOT ONLY GREAT SENSIBILITY, WHICH IS THE MEASURE OF THEIR NERVOUS RELATIONS; BUT THEY ARE COMPARATIVELY WEAK FROM THE REMOTENESS OF THEIR SITUATION TO THE NERVOUS CENTRES. Therefore whenever the nervous system is peculiarly oppressed by its pervading agent, either from its undue accumulation or irregular distribution, this will flow to these extreme parts in preference to others. It is a striking illustration of the efforts of nature to relieve herself.

CCCCXXXV. This explanation we regard as strictly philosophical. It rests on structural conditions and relations which cannot be called in question. In its bearings on this particular inquiry it is valuable. It tends in an especial manner to elucidate the nervous character of gout; and, also, shows why its non-appearance, at regular or irregular periods, in the nervous or irritable frame, should occasionally give rise to different nervous disorders, as epilepsy, loss of motion or sensibility, mania, imbecility and numerous other forms of nervous derangement. It enables us to go a few steps further. It will throw light on the hereditary tendency of the animal system to particular diseases, the study of which is inseparably enwoven with the present investigation. In using the term hereditary, we would not confine it to the production of the same exact malady, but would extend it to a variety of nervous phenomena springing directly out of the disturbed action of the nervous system. A parent may be maniacal, the offspring may be epileptic, morbidly irritable, or subject to severe nervous pains: and in many cases in which gout does not show itself in the progeny, nervous affections of some kind will frequently be constitutional. We will, however, endeavour to analyze the nature of those causes which favour the transmission of the same disease to successive generations.

CCCCXXXVI. It is unnecessary to waste any time in attempting to show, that like has a tendency to produce like, in respect of features, complexion, form, size and motion of body. These are matters of daily observation. Co-existing with them, and even with the absence of them, there is a peculiar character impressed upon the nervous system,—a character which often requires years and extraordinary circumstances to develope, exhibiting in its manifestations hereditary properties, as displayed in the occurrence of epilepsy, mania or gout. The nature of these properties may be defined to be a certain *relation between the animating principle and the nervous system.*

We may speak of this relation as of that between the blood and the vessels in which it circulates. In both cases, the conditions which it implies are peculiar to each individual, but approximate sufficiently to constitute a basis for the several temperaments. As the action of all organic matter is proportionate to the vivifying agent which pervades it, it is evident that the amount possessed by the nervous system will be widely different in the nervous, the sanguineous and the phlegmatic constitution. It will produce in each very dissimilar results. It is that which gives to the whole organism its distinguishing qualities. Whether the function studied be digestion, circulation, absorption, secretion or assimilation, the controlling and modifying power will be found to be the one universally diffused principle. Hence the relation between this and the nervous system transmitted from parent to offspring, is one of the chief causes to which all hereditary diseases are to be traced. Where the quantity of the nervous energy is limited, weak vital action, or a tendency to disorganization, as displayed in the scrofulous and phthisical constitution, is the consequence: where it is abundant and associated with an ample development of the digestive and respiratory organs, the predisposition is to inflammation: where it is, also, copiously given, but not equally expended by the vigorous activity of these organs, the proneness is to a variety of nervous affections.

CCCCXXXVII. As previously remarked, each age has its distinctive class of diseases, which is owing to the successive changes in the conditions of the nervous system. The consideration of epilepsy, mania and gout, will illustrate our views in reference to their hereditary tendency. As a rule, but subject to numerous exceptions, these are manifested at different periods of life. Epilepsy frequently at puberty; mania generally much later, and gout usually for the first time at thirty-five or forty years of age. The period at which epilepsy is most liable to occur, is when the nervous system is aroused to the exercise of new functions, the organs of which imperfectly responding to the stimulus imparted to them, or not fully awakened by the gratification of the predominating desires, there is an amount of the nervous principle which is not appropriated according to the intentions of nature, and therefore this may be regarded as thrown upon the nervous system generally. The results to which it may give rise it is impossible to predicate. If the action of certain parts of the cerebral structure be peculiarly disposed to that species of derangement, whether hereditary or not, which is manifested by epilepsy, this particular disease will be excited; if any other action exist which renders the parts susceptible of disorder, mania, hysteria, vitiated tastes, ungovernable propensities, chorea, or other affections will be the consequence.

CCCCXXXVIII. The same observations apply with equal force to gout. The period of life at which it usually occurs, whether from an hereditary tendency or otherwise, adds great weight to these views. Why does it not ordinarily show itself at an earlier age, when the animal system is in its highest vigour and teeming with vital energies? The question is not difficult to answer. *These energies have outlets proportionately ample,* in the activity of the digestive organs, in the frequent and strongly excited muscular motions, as well as in the liberal indulgence of the passions. The time, however, gradually arrives, when there is less disposition or power to enter into athletic pursuits, or to gratify some of the ruling propensities. The love of ease steals upon the mind, and the evidence of it is displayed in the increasing bulk of the body, and in the augmented rather than diminished taste for the luxuries of the table. Hence a new condition of the nervous system is induced. It is still active, *but the direction of its activity is modified.* It abounds in vital energies, but these have not the accompanying ample outlets of an earlier age, and consequently the nervous principle at this period has a tendency to accumulate, or to become irregular in its distribution, and the indications of it are sometimes various, often slight in degree, and seldom arrest particular attention, until at length the oppressed nervous system finds a safety valve in the production of gout; or it may be, and indeed frequently is, though the nature of the salutary effort is not understood, of some other disease. Life is constantly preserved at the expense of serious maladies.

CCCCXXXIX. In tracing the origin of gout, it must, also, be kept in mind, that the habits of the individual,—especially the indulgence of the appetite and the passions, may give to the nervous system an undue predominance, stimulate it to inordinate activity, and in such proportion aggravate its tendency to terminate in some morbid action. There is another circumstance worthy of consideration. A paroxysm of gout, as well as of epilepsy, often occurs about midnight, or early in the morning. The phenomenon is explicable on the views here developed. The perfect repose of the nervous system clearly leaves unemployed a certain amount of the nervous energy, which had its outlets in the exercise of the senses and of various voluntary organs; and, therefore, in those individuals in whom the powers of the nervous system are delicately balanced, to preserve this balance it issues in a fit of gout or epilepsy. It is an illustration of the necessity of such external manifestation. The severity of the paroxysm gradually declines towards morning, and the remission generally continues until the usual period for the return of the seizure. These successive changes of vital action can alone be accounted for on the physiological considerations here offered. The dawn of day brings new agencies into operation. The effect of light upon the body, independently of all other circumstances, possesses great interest to the philosophical inquirer. It may be accurately traced throughout the vegetable kingdom, in numerous chemical combinations, and, could we analyze with precision its influence on the organism of the animal frame, it would be found to be fraught with remarkable results. Light modifies the electric condition of all substances. When in addition to it we have the activity of the senses and mental faculties, there are causes, in the altered states of the nervous system, amply sufficient to explain the regularity of the remission.

If it be asserted that the principles here laid down do not rest on a sound or unquestionable basis, it must be admitted that they have at least this property, which is always characteristic of truth,—they furnish a rational hypothesis on which to elucidate a vast number of important phenomena, which have hitherto not been accounted for; moreover, many of them are regarded as not susceptible of analysis, eluding the efforts of the physiologist to trace their origin or define their nature.

CCCCXL. Writers who have studied the pathology and symptoms of gout, have failed to discover the cause which constitutes the wide distinction between it and the purely inflammatory affections among which it is classed. Whilst these pass through the several stages of morbid action to suppuration, gout never terminates in the latter process. How protracted or violent soever may be the attack, the structure of the organs is only slightly and temporarily modified by it. Indeed the disease occasionally seizes in quick succession on different parts of the body, leaving no impressions commensurate with the severity of the transient suffering.

Why are the various tissues liable to suppuration as a consequence of inflammation? The induced morbid action soon falls beneath the ordinary vitality of the tissues,—a vitality dependent on the nervous energy with which they are endowed, and to this is to be ascribed the gradual disorganization which ensues,—the breaking up of the normal organic combinations, until nature, when equal to the undertaking, is aroused to the vigorous exercise of her powers, and arrests the progress of destruction by a salutary effort, the effect of which is the formation of pus. Why do not the same tissues suppurate from the ravages of gout? Because it is an excited nervous affection, or in other terms, *it is seated in and characterized by a vastly increased action of the nerves,—an action superior to any existing tendency to disorganization.* A distinction so obvious has escaped all writers. They have observed the striking differences between the phenomena of gout and the inflammatory diseases with which it is classified; but the cause eluded their refined investigations. They never suspected that the nature of the affection was exclusively nervous, distinguished by an inordinate concentration of the nervous principle; while in the inflammatory diseases, this being less in amount, it is rapidly overcome by the morbid process, and hence the results indicating the several stages of inflammation.

CCCCXLI. It is not to be understood from the important distinction which is here insisted upon, that the translation of gout to the internal organs, may not, at times, give rise to those effects which are considered as unequivocal evidence of inflammation. The effects of the disease will be regulated by the nature of the tissues implicated. Though equally a nervous affection in all situations, its influence to counteract the tendency to organic changes, will unquestionably depend on the amount of nerves inherent in the structure attacked. Nevertheless, as a rule, its temporary occupation of any organ will seldom exhibit the ordinary manifestations or consequences of common inflammation.

CCCCXLII. The foregoing considerations are all intimately connected with the inquiry we professed to elucidate in this chapter. The phenomena they have brought under notice, exhibit in a striking point of view the modifications in the conditions of the nervous system, in health and disease, and the consequent changes in the nature of vital action. They display, though only to a slight extent compared with the light which would be elicited by a more elaborate investigation, the vast and predominating influence of the nervous energy in all the operations of life.

To some persons many of these inquiries will appear far too refined for practical purposes. They cannot be too refined if justly founded. The more minute the objects they bring under notice, and the more exquisitely delicate the shades of difference they establish, and proportionately the more comprehensive is the insight obtained into the workings and relations of the vital powers. The command we acquire over them is in the ratio of our knowledge. The progress that will ultimately be made in this important branch of science, will give such elevation to the mind that these researches will be regarded as only the first turning up of a soil inexhaustible in its riches.

CCCCXLIII. The comparative indifference with which the study of physiology has hitherto been regarded, will satisfactorily account for much of the prevailing ignorance on the origin, nature and treatment of diseases. The vast resources with which it teems in the hands of the enlightened practitioner, to arrest or modify the course of morbid action, and at the least possible expense to the vital energies, one of the most important of considerations, are appreciated by few, and rarely are they objects of philosophical contemplation. To understand generally the functions of the several organs of the body, is of little value in a practical point of view, and this amount of knowledge is often the whole that is possessed. No organ has an independent existence, nor is it endowed with properties, which, in an enlarged physiological sense, are inherent in it. It has the mechanism which fits it for the performance of its office, but it borrows from other parts of the animal system the powers essential to put it in motion. All organs are equally borrowers, and hence the necessity of an accurate and comprehensive knowledge of these powers, and of their beautifully adjusted relations to the entire organism in every attempt to correct the multifarious deviations from health.

CCCCXLIV. From the investigations into which we have somewhat elaborately entered, in order to display the predominating influence of the nervous system, it is evident that the morbid phenomena resulting from the interruption to the return of a periodical or constitutional disease, are not to be ascribed to an "increased determination or momentum of blood," according to the doctrine of Parry. The modification in the condition of the capillaries locally disordered, is an effect originating in the altered state of the nerves. Parry attempts to show, "that almost all the maladies, incidental to the animal frame, have this very circumstance of excessive momentum of blood, as one important common link in the great and connected chain of causes; that is, of uniformly preceding phenomena:" * and the same view has been adopted and variously applied by the ingenuity of others. In all such cases it is the nervous and not the circulatory system which will in any degree account for the extraordinary results. As it is the principle animating the former which is the occasion of all vital manifestations, it necessarily follows that every new action abruptly and unexpectedly developed, whatever may be the region attacked, is alone due to a change in the distribution of it. It is unphilosophical in the extreme to imagine, that the non-appearance of a few drops of blood in the ball of the great toe, at some regular or irregular period in harmony with the hereditary tendency of the constitution, should be capable of endangering life by being thrown upon the stomach, the intestines, the spinal cord or the brain, an outlet being imperatively required by the existing state of the

---

* Opus cit. p. 298.

vessels. The argument will not bear a sober examination.

It was the opinion of Bichat, that "an increase of *sensibility* is prior to the afflux of blood to the part."* This is in reference to vital alterations in a tissue as the first step in all diseases, a subject which does not strictly fall within the scope of this inquiry. But what is the value of the doctrine when analyzed? He ridicules throughout his writings the idea of a nervous principle.

An increase of sensibility is a modification of nervous structure. Is it reasonable to conceive that this is destitute of a vivifying energy,—a something distinct from the gross and palpable matter of which it is composed? Are not all substances, whether organized or not, pervaded by some agent, and shall we deny it to the nerves, which in one situation perform the office of sight, in another of smell, in a third of taste and in a fourth of hearing? Can there be a change in nervous matter independently of that power in virtue of which it unquestionably manifests its various properties?

---

* *Vide* Pathology founded on the Natural System of Anatomy and Physiology, a work which reflects great credit on the ingenuity and analytical powers of the writer. By Alexander Walker, p. 116.

the right leg, including the knee-joint, were immediately affected; and in about thirty-six hours the disease disappeared from these parts and became concentrated in the balls of the great toes; but on the second day altogether quitted them, and located itself in the right elbow joint where it remains.* The occurrence, and the unsettled character of the morbid action, we conceive to be explicable on the views we have attempted to elucidate. In harmony with these they show that a certain amount of the nervous principle, which had been concentrated in the lungs during the continuance of the inflammatory process, being set at liberty on the sudden and unexpected amelioration of the urgent symptoms, and unemployed by the ordinary vital operations of the system, the phenomena resulting are to be ascribed to its irregular distribution.

CCCCXLVII. It will not be doubted that every morbid action becomes a centre of accumulated nervous energy. And if from spontaneous or induced changes in the state of a diseased organ, it is no longer required in maintaining the locally excited vital conditions, it will be determined to certain regions according to their susceptibility, the nature of which it is difficult to explain. Were it the circulatory system that was struggling to re-establish its balance, the blood would not flow in undue quantory to the hand, or subsequently to the knee-joint and the neighbouring muscles, but as a rule to the internal viscera. In those cases in which it appears to select the former, or similar parts of the body, as indicated by their increased vascularity, it is invariably the consequence of a previous change in the properties or action of the nerves involved.

---

* It has since quitted the elbow joint and is now located in the lungs, producing its originally aggravated symptoms.

It is these which regulate the course or motion of the blood throughout the last divisions of the circulatory system. If the nerves are inordinately excited, the arterial current is drawn in the direction of the capillaries; if depressed or deficient in the stimulus which they impart to living matter, these vessels gradually lose the invigorating and vitalizing stream. The transmission of it, and all its diversified operations, are modified according to the amount of the existing nervous energy.

CCCCXLVIII. The want of a just appreciation of the cause of the metastasis of disease has led to serious errors in practice. In studying the origin and nature of the symptoms which presented themselves, with whatever region they might be connected, the part which the nervous system plays in the production of them, has scarcely been at all investigated and consequently little understood. An accurate conception of the mode in which it influences the properties and motion of the blood would exhibit, in a strong light, the generally baneful effects of all active depletory measures, not less in reference to the permanent deterioration of the constitution, than to the fatal results to which they often immediately lead. The object of the physician should be to accomplish the greatest amount of good, not only in the least time, but at the smallest possible expense to the energies of life. The conservation of the blood and of the nervous power should be his especial anxiety. Of the former, we can treat as of a fluid falling under the cognizance of the senses: of the latter, only so far as we are enlightened by a refined analysis of the phenomena which it manifests. Of its reality, as a principle in virtue of which matter displays its various properties, we entertain not a doubt. The accuracy of this opinion, however, is not necessary to the exposition of practical errors, or the elucidation of the views developed in these pages. The ordinary language employed in speaking of the nerves, as endowed with a certain power, is amply sufficient for the general purposes of this inquiry.

CCCCXLIX. In the treatment of numerous diseases, and especially of those arising from metastasis, (the symptoms of which often appear to demand exceedingly active measures,) the prevailing theory, that they originate in the determination of blood to some particular organ, which is thought to be established by the strong and frequent pulse and other accompanying symptoms, has exerted, as we shall attempt to show, an extremely prejudicial influence on the selection and application of remedies.

All modifications of the circulatory apparatus, whether the phenomena be those of excited or depressed action, are to be traced exclusively to the altered conditions of the nervous system. It is this, and this alone which will explain the full and bounding pulse which so often characterizes the conversion of diseases, and unfortunately has been regarded as authorizing the copious abstraction of blood and other debilitating measures.

To illustrate the views bearing on this subject, in all their important practical relations, we will suppose an individual to be suffering somewhat slightly from a rheumatic seizure of the muscles of the loins. The functions of life are little disturbed. The pulse and the temperature of the body exhibit scarcely any deviations from health. From some irregularity in diet or exposure to cold or wet, the knee-joints are subsequently attacked. We have now a different class of symptoms. The pulse will probably be full, strong and greatly accelerated; the animal heat proportionately increased giving rise to what is designated acute inflammatory fever. The usual practice in such a case, by the highest authorities, has been to deplete most freely. The change in the morbid action has not occasioned any increase in the volume of the blood. It is precisely the same as when the system was unexcited. It is simply modified in its distribution. And in what manner? There is a continual variation in the amount of blood contained in the arteries and veins. It is never constant in either. When the vital powers are in any degree depressed, the veins gain at the expense of the arteries: if the same powers are aroused by internal or external causes, the arteries gain at the expense of the veins; and hence as in the above, and in all similar circumstances, an immensely augmented quantity of blood is thrown into the arterial system. We will further endeavour to explain how this occurs.

CCCCL. As a general rule, the influence of any local irritation will be according to the number of nerves associated with the texture or organ involved; or according to the nervous relations which it maintains with the nervous system. The knee-joints possess largely both conditions, their frequent, long continued, and often violent motions, necessarily require a great amount of nervous power, and obviously extensive connexions with the important nervous centres. It is, therefore, clear that the nerves liberally distributed to these joints, will, when stimulated to undue action, be peculiarly disposed to excite the whole of the nervous system. The extraordinary concentration of nervous energy and the exquisitely acute sensibility resulting, will implicate in the induced derangement the brain and the spinal cord, and thus equally the nerves of animal and of organic life, Not only has the arterial apparatus a vastly increased amount of blood circulating with an invigorated impetus through its numerous channels; but the nerves, also, are more abundantly endowed with the animating principle, and it is this awakened to a wider sphere of operations, to higher capabilities of action, that accounts for the strong and accelerated contractions of the heart and arteries, for the quickened respiration, the more oxygenated qualities of the blood and the augmented generation of animal heat. The principle infuses new life into every molecule of living matter.

On this view alone is it possible to explain the diversified phenomena. If it be well-founded, does it not offer any glimmerings of light on the important subject of medical treatment? Can it be philosophical to regulate this from any existing condition of the pulse, irrespective of a thorough knowledge of the nature of the causes out of which it springs? Are we to forget that the effects, how striking or various soever they may be, are to be ascribed exclusively to the modified properties of the nervous system; or that the means to be prompt, efficient and safe, should have a direct reference to the influence it unceasingly exerts?

CCCCLI. Is it not clear from this brief analysis of the agency of the nervous system, that serious mistakes in practice have arisen from regarding the symptoms generally of excitement, as inflammatory in their character, and consequently requiring a free and often repeated abstraction of blood? The full pulse, the florid appearance of the blood, the readiness with which it coagulates when drawn, and the abundant formation of crassamentum, are conceived to be unerring indications of the correctness of the prevailing opinion, and of the necessity of active depletory measures. The success which may follow the treatment, is no evidence of the justness of the considerations which suggested it. The great object is indisputably to cure, but there is another second only in importance to it, *viz.*, that it shall be effected at the least possible expense to the energies of life. The consequences flowing from the reckless perseverance in injudicious and energetic practice, are frequently far more to be dreaded than the disease itself.

We will endeavour to exhibit the force and propriety of these observations by the analysis of a case related by a distinguished authority, given as an illustration of the metastasis of dropsical inflammation to the brain, occasioning convulsive or maniacal affections. It is not selected as a rare instance of treatment founded on an imperfect knowledge of the condition of the vital powers. Medical writings abound in such examples.

An individual, "aged thirty-four, was admitted an in-patient at the Infirmary, labouring under anasarca, on September 20, 1820. He had been ill of that disease *six months. He was bled, took purgatives and diuretics*, and seemed to be getting rather better, until the night of the 28th, when he was attacked by diarrhœa, and pain in his bowels.

On the morning of the 29th, he was seized with a convulsive fit, which lasted about half-an-hour. About an hour after the fit he was lying comatose, but very restless, turning constantly about. Pulse about 95, and full. Pupils natural.

V. S. et fl. ℥ xvi.
Epispast. ad nucham, Capillis Abrasis.

He had several fits during the day. In one of these, which took place about four o'clock, he was much convulsed, foamed at the mouth, respired with a deep sound, About ℥ xx of blood were taken from the temporal artery, and a sinapism applied to the nucha, the blister not producing any effect, and he was ordered two grains of elaterium every fourth hour.

30th. He has taken five of the powders. His bowels have been opened three or four times, *and once or twice involuntarily.*

He has partially recovered his consciousness and perception; but when left undisturbed, lies asleep, breathing sonorously. Pulse 88; strong. *He is under an almost constant tremor, resembling rigor of ague, but so strong as to shake the bed.*

Hirudines xxx Capiti.
Vesic. ampl. Nuchæ.
Sinapism. ad pedes.
℞ Calomel. gr iv
Elater. gr ii.
Pulv. Digital. gr i.
4tâ quâque horâ.

Oct. 1st. Gradually sunk and expired.

Dissection.—Six hours after death. A great quantity of blood flowed from the incision in the scalp; and when the skull-cap was removed, and an opening made into the longitudinal sinus, fully half a-pound of blood flowed out; which, after standing some time, coagulated, *the veins of the brain were rather turgid*, and would doubtless have been more so if the sinuses had not been opened first. There was a slight effusion of serum under the arachnoid membrane, and in the ventricles."*

It is an ungracious task to animadvert on the practice of others. The case, however, is illustrative of treatment only slightly modified in activity at the present day, and in this point of view is worthy of consideration. Here is a person who had suffered six months from anasarca, the long continuance of which would necessarily undermine the energies of the constitution. He is at once *bled, takes purgatives and diuretics.* Nine days after he is again bled from the arm to the extent of sixteen ounces, and twenty ounces are likewise taken from the temporal artery. The next day thirty leeches are applied to the head. The patient loses, in this brief period, about five pounds of blood, and if the effects of the repeated purgatives and diuretics be further taken into account, the actual loss to the circulatory system far exceeds this calculation.

---

* A Treatise on Diseases of the Nervous System. Part the First, p. 226. By J. C. Prichard, M.D.

CCCCLII. This case is full of instruction both in its physiological and pathological relations. It cannot be adduced as an instance of the metastasis of dropsical inflammation to the brain. We hesitate not to assert that the aggravated symptoms were the immediate consequence of the medical treatment. Had the anasarca been recent and originating in acute inflammation, occurring, also, in an exceedingly robust constitution, the practice could not have been more active or persevered in with greater pertinacity. The patient had had no fits until bleeding, purgatives and diuretics were employed, and by the subsequent abstraction of blood they were augmented not only in frequency, but in a remarkable degree in the severity of their attacks. He ultimately became convulsed and foamed at the mouth. After the enforcement of further depletion, he was in a constant tremor, and shook the bed as if suffering from the rigor of ague, and yet with all these extraordinary indications of exhausted nervous power, thirty leeches were applied to the head after which he expired.

CCCCLIII. The dropsical affection was associated with great debility of the functions of life generally, and this was further increased by the treatment, rendering the nervous system unequal to the performance of its duties. Hence the fatal results which followed.

The appearances of the brain on dissection may be shown to corroborate these observations. The congestion of the cerebral structure, largely venous in its character, is no evidence of the previous existence of acute inflammation. The circulatory system became so weakened by the repeated depletion, that the blood, at length, could no longer be maintained in motion, and consequently it would accumulate where it met with the least resistance, as in the longitudinal sinus and the veins. The deterioration of its properties, conjoined with the enfeebled and disordered state of the capillaries, will readily account, in cases of this description, for the frequent effusion of serous fluid into the cavities of the encephalon, as well as in other situations. It is not in this instance, to be ascribed to the translation of inflammatory action to the brain; nor to the absorption of the fluid from other regions and its subsequent deposition in the ventricles. Under these circumstances there is a general tendency to its effusion throughout the body, which is to be traced to a modification in the constituents of the blood, and the diminished tone or vital energies of its numerous vessels. It is not, however, intended to imply by these remarks, that what is designated inflammation, may not often give rise to the diversified phenomena of dropsy.

CCCCLIV. The structural conditions discovered after death, furnish no steady light, in such cases, in respect of the nature of any pre-existing morbid action. The misinterpretation of them has led to much illogical reasoning and injudicious practice. It frequently happens, and the fact is stated by the highest authorities on nervous diseases, that in numerous instances in which death occurs from the metastasis of disease, no appearances can be detected on dissection to account for the origin, progress or fatal termination of the malady. And it is, also, equally indisputable, that many of the structural changes to which great importance is attached, are often results produced by the treatment, or consequent on the embarrassed state of the vital powers, and are not to be regarded as the particular manifestations of the cause which occasioned the urgent symptoms.

CCCCLV. It is impossible to give a satisfactory explanation of these different effects on the prevailing views of inflammation. The attention of all writers has been fixed upon the state of the capillaries during the several stages of it, and various appearances have been received as evidence of the abnormal action. As a rule, they are generally present, but not necessarily so. Symptoms exceedingly aggravated may exist, indicating, according to the adopted notions, the severity of acute inflammation, and yet scarcely the slightest structural modifications will be discovered after death. Inflammation is to be defined, AN INORDINATE ACTIVITY OF THE NERVES IMPLICATED IN THE INDUCED MORBID PROCESS. If a large amount of nervous matter, as the brain, the spinal cord, or the nerves of the joints be attacked, it will generally be accompanied with all the remarkable manifestations of acute inflammation, as the quick, full and bounding pulse, great heat of skin, increased temperature of the body, and the more highly oxygenated qualities of the blood; and yet the particular structure, the source of all these phenomena, if it give rise to fatal results, will frequently exhibit, after death, no structural changes in any degree proportionate to the violence of the pre-existing symptoms. How is this to be explained? Certainly not on any of the prevailing theories of inflammation, which seek a solution of the difficulties in the altered state of the minute vessels, and the consequent disordered circulation in them, or in the modified qualities of the blood. A cause is to be sought which may produce all these effects, and yet it is to be shown that they do not necessarily flow from it. That cause is the animating principle of the nervous system. The acuteness of the symptoms is in the ratio of its concentration, and of the influence which this exerts in disturbing the functions of life generally.

CCCCLVI. The effects usually ascribed to inflammation are not so much a measure of its intensity, as of the structural properties of the different organs predisposed to exhibit the traces of it,—properties which no writer has attempted to investigate, or alluded to in their important relations to the subject under consideration. The conditions which these properties imply, explaining the occurrence of the well marked vestiges of inflammation, are Firstly, The degree of vascularity possessed by an organ. Secondly, The influence which its disturbed function exerts in impeding the motion of the blood within the implicated structure. And Thirdly, The facility with which the congested or excited organ can relieve itself by secretion, or by any other vital operation.

An analysis of these conditions will show, that a corresponding intensity of inflammation in the various organs, will necessarily give rise to very dissimilar pathological effects, the thorough understanding of which is intimately connected with the inquiry into the metastasis of disease.

We will endeavour briefly to exhibit the application of these views to this particular inquiry. The lungs illustrate, in an extraordinary manner, the two first conditions. They are extremely vascular, and a trivial derangement of their functions readily produces the obvious manifestations of structural changes. If, while attacked with inflammation, the patient die of some other disease, it is not at all unusual to find these organs affected in a far greater degree than we had been led to expect from the symptoms during life,—save such as are furnished by percussion and auscultation. They quickly lose their ordinary elasticity and become unequal to the performance of their offices.

These effects are not to be regarded as a measure of the severity of the previous inflammation, *but as a* *measure of the influence of the proximate cause of it,—the disordered action of the nerves,* to produce extensive alterations in the motion and distribution of the blood within the lungs, facilitated in a peculiar degree by the structural conditions of these organs. It is important to make a distinction between effects resulting from the extension of a morbid process, and effects which follow indirectly from it, having indeed no more connexion with the inflammation, than similar co-existing changes in any other part of the body. In the examination of the organs, after death, we may discover portions of their structure variously diseased, but to separate the direct from the indirect consequences flowing from the morbid action, is a task fraught with some difficulty. It may, nevertheless, be accomplished to a considerable extent.

The same views and reasoning may be applied to the liver, the spleen and the kidneys, though these organs will not exhibit the vestiges or consequences of inflammation in the same aggravated forms.

CCCCLVII. The whole of the mucous membrane illustrates the third condition. It is abundantly endowed with nerves and blood vessels, but its surface, with whatever structure it may be connected, possesses this peculiarity,—it always communicates with an external opening, a circumstance which may be shown to modify in a remarkable manner the appearances that it would otherwise present from the pre-existence of inflammation. This frequently destroys life without leaving traces of its action proportionate to its severity. A circumscribed patch of redness, or slight congestion of the vessels locally, is often the only structural change detected. This is no accurate measure of the intensity of the previous inflammation,—an intensity which consisted in the concentration of the nervous principle. The extensive modifications which this would produce in the condition and functions of the membrane, during the continuance of life, were less permanent in their obvious effects, than if they had occurred in the lungs, from the facility which the membrane possesses of relieving its congested and otherwise disordered vessels, by secretion, aided by excretions arising either from the efforts of nature or the remedies employed. The pathological conditions furnish, therefore, no correct indications of the aggravated character of the inflammation, in numerous interesting and fatal cases, occasioned by the metastasis of gout, rheumatism or of any other affection, to the stomach or intestines.

CCCCLVIII. These brief and imperfect considerations of the causes modifying the agency of disease on living structures, or accounting for the different degrees of disorganization displayed by them, after death, from the ravages of inflammation, have sufficiently prepared the way to enable us to explain, on strictly philosophical grounds, why the translation of excited morbid action to the brain or the spinal cord, or such action originating in either of them, should, when fatal in its effects, frequently leave scarcely any impressions of the vast influence which it exercised. The inquiry never suggested itself to the mind of any writer, nor could it readily arise, except in connexion with researches into the diversified operations of the one pervading principle of the nervous system. The point of elevation from which it was to be viewed, in all its practical relations, could be attained only through the medium of such investigations elaborately and patiently pursued.

The brain and the spinal cord are regarded, and justly, as highly vascular. They unquestionably receive a large amount of blood, but this is peculiarly situated in reference to the nervous tissue in which it circulates, and the functions to which it ministers. It does not exist in these organs, as in the lungs, in large quantities to be acted upon by external agents; nor is it abundantly distributed to them as in the liver, the mucous membrane and the kidneys, to be expended in the secretion of matters which fall under the cognizance of the senses. Its office is to supply necessities of a far more elevated description,—the operations of the mental faculties, and the channels in which it moves are proportionately more attenuated; or, in other words, the blood is divided into much finer currents in nervous tissues than in any other organic structure. The more minute its divisions, and the more is its motion under the controul of nervous power, consequently the less liable will its vessels be to congestion; and, also, the less influential in producing this condition throughout the cerebral mass, because each string of globules has a certain degree of motion independent of the rest, or of the temporary causes which may disturb any portion of them.

To show the application of these views bearing on nervous affections generally, but especially on the metastasis of disease, we will suppose the morbid action constituting gout, to be suddenly translated to the brain. The first question which forces itself on consideration, is, what is it which thus capriciously changes its locality? The only philosophical answer is, the nervous principle. We have shown why in its connexion with the nerves of the ball of the great toe, or in other regions, it does not produce the ordinary effects of inflammation. On quitting the structure in which it was concentrated, the vessels immediately recover their natural calibre; and acute sensibility, as well as all trace of congestion, disappear. The same reasoning applies to the excited action set up in the brain, the spinal cord, and in all nervous matter. It is an action possessing precisely the same relations to the vessels locally implicated. It confers on these, for the time being, an extraordinary degree of activity, and from its persistent character, the vessels do not, as in common inflammation in other situations, allow the blood to stagnate in them causing the congestion to extend until a large mass of the organ becomes involved. When the activity subsides from the decline or fatal progress of the malady, the minute vessels quickly resume their usual conditions and consequently we shall not discover, after death, those pathological appearances in the brain, the spinal marrow, or the nerves, which would be a just indication of the severity of the pre-existing inflammation.

CCCCLIX. It is only, we conceive, on these considerations, that a probable explanation can be given of the absence of serious structural changes where the translation of disease suddenly occasions death. The frequent absence of such effects, is admitted by all writers. Dr. Prichard observes, "Mr. Abernethy mentions that he has seen three instances of affection of the head supervening on the metastasis of rheumatism, in which the patients died comatose; yet, on dissection, no other morbid appearance was discovered than slight marks of inflammation in the pia mater. The inference which results from these cases, compared with other analogous phenomena, is, unless I am greatly mistaken, not that the disease which has attacked the brain is not of the nature of inflammation, but that acute inflammation of the encephalon, coming on under such circumstances, is capable of destroying life during its first stage, and before any of those changes of structure have supervened which are often so strongly marked in cases of cerebral affection, *and while the disease is of that kind which leaves comparatively slight vestiges;* such as mere discoloration of membranes, and increased turgescency of blood vessels."*

The inflammation in these cases must be acknow-

Opus cit. p., 224.

ledged to have been exceedingly acute, and when it quickly destroys life, from attacking the lungs, the trachea or the liver, it never fails to leave well-marked vestiges of its previous existence. If the excited action in the brain were associated with structural conditions, analogous to those which distinguish these organs, the traces of its aggravated violence would invariably remain. It is not its brief persistence in the cerebrum that explains the phenomenon, but the intensity of its action, parodoxical as this may appear, *and such action occurring exclusively in nervous matter.*

CCCCLX. In many of the fatal instances in which the substance of the brain is scarcely perceptibly altered, the investing membranes of the organ are usually observed to be more or less congested. This is a result which would be anticipated from the views here developed. The vessels of the membranes are placed under very different circumstances from those in the cerebral mass, and the just appreciation of them will account for their more general and permanent derangement. The *pia mater*, from its great vascularity and extensive distribution, entering not only into all the sulci and fissures on the surface of the brain, but sending highly vascular processes into the several ventricles, is by far the most important of the tunics, and will most aptly illustrate the physiological distinctions we are anxious to point out. Innumerable minute vessels pass from the *pia mater*, in all directions into the nervous substance, establishing extensive relations with it, and it is the consideration of this fact which will account for the frequent congestion of this membrane, where the brain has been the seat of acute disease. The excited action will, as already stated, greatly derange the circulation in it, and, as an inevitable effect, will tend to retard, arrest, or disturb the course of the blood, especially in the vessels of the *pia mater*. The facility with which these are enabled to discharge their contents, will depend on the circulatory conditions of the cerebrum; these being abnormal for the moment from the existing inflammation, or concentrated nervous action, causing epilepsy, apoplexy, mania, or a comatose state, the blood will clearly accumulate in the vessels of that tunic which has the most intimate relations with the nervous substance; somewhat in the same manner as the lungs, and all other organs, are liable to congestion from the influence of the same cause. And it is probable that the well-marked pathological appearances frequently detected in the investing membranes, are to be referred chiefly to the disordered cerebral circulation, modifying the course and condition of the blood in them in the way here explained.

CCCCLXI. The physiological inquiry into which we have only imperfectly entered, in the endeavour to account for an interesting class of morbid phenomena, would appear to suggest one, and, perhaps, the important use of the ventricles of the brain. All organs, if studied in a truly philosophical spirit, may be shown to be endowed with such structural arrangements, or to be so situated in the exercise of their functions, that their occasionally disturbed action has invariably a species of safety valve, by which it is enabled to throw off matters, which, if retained, would be injurious, or to relieve undue pressure which would be equally detrimental. The investigation of the different organs, in this point of view, would be worthy of the analytical genius of a Paley. It is not our business here, however, to pursue it in its important and comprehensive relations to life. The ventricles are to be regarded in this light in reference to the brain. When this from inordinate excitement, or from any other cause, has its circulation greatly accelerated or its numerous vessels congested, the almost universal consequence, is, an increased secretion of serous fluid. This may, or may not be the result of what is designated inflammation, but when it occurs, within certain limits, it is of vast relief to the embarassed vessels, as well as to the brain. It accumulates in the ventricles, where its presence will be fraught with the least danger to the mental faculties and the vital powers.

That such is one of the vital functions they perform, is strengthened by another consideration. The ventricles communicate with each other and with the spinal cord; a circumstance which is favourable not only to the distribution of this fluid, but to the equalization of its pressure: and further, these conditions will facilitate its absorption on the cessation of the exciting cause.

CCCCLXII. The foregoing physiological researches are inseparably connected with the study of the metastasis of disease. They tend to explain the frequent absence of morbid cerebral effects proportionate to the aggravated nature of the pre-existing symptoms. The solution of the difficulty has not hitherto been attempted. The only explanation that has been offered, is, that the disease had not existed sufficiently long to produce a change of structure. If it attack, however, other organs for the same brief period, with a corresponding degree of severity, the vestiges of its violence are always easy of detection. It is therefore clear that the difference in the results is explicable only on the preceding considerations.

CCCCLXIII. It is unnecessary to give an elaborate detail of cases illustrative of the metastasis of disease, or of the views which are here offered in explanation of it. How varied soever the phenomena to which it may give rise, they are all equally to be referred to the disturbance in the distribution of the animating agent of the nervous system. Whether the effects be the production of epilepsy, mania or delirium from the translation of gout or rheumatism to the brain; or asthma, phthisis, gastritis, or enteritis, resulting from the capricious changes of the morbid action, they are all occasioned by the same general nervous condition, and hence it would be a waste of time to exhibit the application of the principles to each individual case.

CCCCLXIV. In analyzing the nature of this morbid action, and the diversified pathological phenomena it excites, in every tissue and fluid of the body, certain remarks are naturally suggested in reference to the measures usually employed in the correction of them. These have mostly been largely depletory in their character. The abstraction of blood locally and generally, and the enforcement of active purgatives, have constituted the influential part of the medical treatment. This has been adopted from two considerations:—the acuteness of the inflammation in these nervous affections, and the prevailing impression that it was to be controlled only by such means.

CCCCLXV. There is no greater error in medical practice, than the recklessness, or indeed the thoughtlessness with which the living stream is withdrawn from its channels. Its value is never sufficiently appreciated. Its abstraction is unquestionably one mode by which inordinate action may occasionally be subdued in these cases; but even when the object in view is attained, it is at the expense of the tone and energies of the animal system, the restoration of which is always a tedious process, and often imperfectly accomplished. Were we to reflect that the blood is not increased in quantity, but simply modified in its distribution and properties by the occurrence of inflammation; and further, did we endeavour to understand clearly, the fact, these investigations tend to prove, that the diversified effects are to be traced exclusively to the agency of the nervous system; it would be impossible not to perceive that there are safer and morefficient means within our command, suggested by a knowledge of the powers of this system and of the manner in which it may be influenced, to controul the existing inflammatory process. To abstract the blood, in the hope to arrest it, irrespective of the consideration of its relation as an effect springing out of the prevailing nervous condition, is a clumsy, a dangerous and an unphilosophical measure. The success which may accompany it, is no evidence of the propriety or justness of the course adopted.

CCCCLXVI. If gout or rheumatism does not yield to copious bleeding or repeated purgatives, why should the translation of the morbid action to the brain, the heart, the stomach, or to any other viscus, render the disease more amenable to the same treatment? It is in all situations equally nervous in its nature, modified only in its manifestations by a difference in the structures implicated.

The greater part of the phenomena displayed by nervous affections, even when to ordinary observation they appear to depend on the presence of what is considered inflammation, originate in a debilitated or exhausted state of the nervous system, and consequently the symptoms will frequently become more aggravated in proportion to the activity of the usual means employed. If such be not the direct source of the phenomena, they may generally be traced to the undue concentration of the nervous energy, and in either case, the treatment is equally fraught with danger.

CCCCLXVII. It is not our business in this place, to develope in all their comprehensive bearings, the principles which should govern the treatment of nervous affections, whether arising from metastasis or any other cause. The importance of the subject demands far more space than can be allotted to its examination here. That further light is required will be admitted by all. The evidence of it is displayed in the exhaustless catalogue of remedies had recourse to, and the very different pathological views by which they are suggested. The three kingdoms have been ransacked for specifics, and each has in turn furnished them. We must again, and in conclusion, repeat, that there is one course only which can possibly lead to the establishment of juster notions, and that is the study of the functions of the nervous system, of its relations to every living fibre, and of the influence which it exerts in health and disease, in virtue of that principle from which it derives its vitality and power.

CHAP. V.

THE PRACTICAL DEDUCTIONS WHICH FLOW FROM THE PRECEDING INVESTIGATIONS, IN REFERENCE TO THE NATURE OF DISEASES GENERALLY, AND THE ACTION OF REMEDIES.

CCCCLXVIII. EVERY new truth or principle evolved in the course of investigation, whatever be the department of science to which it belongs, is always fruitful in its applications. It gives to the mind a new and a higher point of observation, by which it is enabled to survey a greater number of phenomena, and in relations not previously studied. This is strikingly and beautifully displayed throughout every branch of physical science. Physiology is certainly not equally rich in illustrations of the fact, though it offers many of an exceedingly interesting character. The fault lies less in the difficulties inseparable from all inquiries into the powers of life, than in the want of juster and more philosophical views in those whose business it is to analyze and treat disease. The established, or prevailing routine of practice, is almost an insuperable obstacle to the introduction and appreciation of any new light, from whatever source derived. It is met with objections on the ground, if any be assigned, "that we do not perceive in what way the remedy operates, or on what principle its efficacy can be explained," as if indeed they were more enlightened in regard to the measures which they usually employ. The greatest of all labours, is to teach mankind to think. To impart knowledge is a task comparatively light, but far otherwise to impregnate it with a spirit of research which alone gives it a high value.

CCCCLXIX. In the endeavour to exhibit the importance of the nervous system in all vital actions, or rather the agent by which it is animated, we have shown that the origin of diseases generally is to be ascribed to changes in the functions of this system; and hence it necessarily follows, that to correct these diseases, whatever be their nature, the remedies should exercise a direct influence on nervous matter. The more immediately they affect it, and the more marked will be the beneficial results. The observation applies not simply to those morbid deviations which are termed nervous, but to every species of disordered action.

The elaborate distinctions of the nosologist are not without their use. They facilitate the classification of symptoms, and so far enable the understanding to seize them with greater ease. They are not, however, without their disadvantage, and one which is fraught with serious practical evils. In proportion to their refinement, is the tendency to create partial and imperfect notions of the nature of disease and of the constitution of the animal economy. The mind is taught to concentrate its attention on fractional parts, in place of embracing within its grasp the powers entering into the composition of the whole. The relations by which these are united, and the mode in which they co-operate in the production of phenomena, whether normal or otherwise, are little understood. The just conception of them is scarcely possible, so long as these refined distinctions are regarded as marking out diseases essentially different in their origin and nature; or what is equivalent in a practical point of view, so long as they are permitted to withdraw the attention from the important fact, that they are all to be traced to modifications in the condition of a few principles of the animal system. The variety of the symptoms, or the forced and laboured grouping of them, must not lead us from the consideration of this vital truth.

The following extract, from the work of a distinguished authority, contains sentiments not altogether inapposite to the spirit of these remarks. "It has always appeared to us," he observes, "we must confess, that the help which the classification of instances, under their different titles of prerogative, affords to inductions, however just such classification may be in itself, is yet more apparent than real. The force of the instance must be felt in the mind, before it can be referred *to its place in the system;* and before it can be referred or appreciated it must be known."[*] The symptoms are the instances in question, and on the prevailing doctrines of the pathologist, they do not admit of a philosophical classification. They are not referred to any system or general principles, in such a manner as to show the relations of any local affection to the powers of the animal economy, without which the classification is comparatively worthless.

CCCCLXX. If the views developed in the preceding investigations be justly founded, the deductions which follow are neither few nor unimportant in their practical bearings. They unequivocally prove that the first link in the lengthened chain of morbid action is a change in the condition of nervous matter, and that the consequent phenomena, how diversified soever they may be, are invariably the result of such change. The particular symptoms which fall under observation, more or less exhibiting the derangement of the functions of life, are to be analyzed in their two-fold aspects:—first, as evidence of the aggravated nature of the effects, and in the second place, as accurately indicating the disordered state of the nervous system, the source whence they directly spring. It is the former, irrespective of all considerations concerning the influence exercised by the latter, which has hitherto almost exclusively regulated the selection and application of remedies.

---

[*] J. F. W. Herschel, opus cit., p. 183.

If the symptoms are those of increased action, every possible mode of diminishing it, by abstracting the vital fluids, is employed. Venesection, purgatives, diaphoretics and diuretics, are among the means which are promptly and actively enforced. The whole treatment is one unbroken tissue of unreasoning routine. Were any clear notions entertained concerning the agency of the nervous system in the production of the morbid effects, in the majority of the diseases which fall under notice, a much safer and a readier path would open itself on the mind by which to arrest or mitigate them. It would be safer, because the measures would economize the expenditure of the vital energies. It would be more direct, because they would immediately act on the abnormal condition of nervous matter. The remedies which have such application, if judiciously used, would accomplish the desired object with far greater certainty, and with much less constitutional derangement than usually follows the received modes of treatment.

CCCCLXXI. The views here developed suggest a further consideration. If the medicinal agents employed are to produce a beneficial effect, or a general impression on the powers of life, is it not a self-evident truth, that they must have free scope for their operation? Is it not the height of absurdity to combine them with others whose action is widely different? What is the character of prescriptions generally? Are they not composed of various ingredients, each having its specific action, and is it to be supposed that this mixed and clashing influence can possibly be the shortest road to the correction of the existing evils? The tendency of the one ingredient may be to excite the vital powers,—that of another to allay them,—that of a third to promote particular secretions, and yet all these, or matters equally heterogeneous, are associated, and the combination is regarded as unexceptionable practice.

It is not in this manner that disease is to be efficiently combated. To set up different *foci* of action, at the same moment, when a general, or a powerfully local effect is to be attained, is at variance with all sound reasoning. It would be as rational to divide a stream into diverging branches, when the object is to concentrate its forces to a given point. And yet those who advocate and implicitly adopt this treatment, are in arms against the introduction of every thing opposed in principle to their own, and chiefly on the consideration that they do not understand its mode of operation. What do they understand of their own course of procedure? If their views are clear and definite, why should the greatest possible discrepancy exist among their own body? Scarcely any two regard a disease in the same light, or treat it with the same combination of remedies. What will an after age think of the philosophy of the present in its relation to the healing art?

CCCCLXXII. There is another matter which these investigations suggest. It is not only necessary to consider the nervous system as the source whence all morbid action originates, and hence the propriety of selecting the appropriate remedy to control it; but it is equally important that the dose, the mode of its exhibition, and other accompanying circumstances, should be weighed with nicety and judgment. To vary the quantity of a remedy, is not simply to modify the degree of its action, but often altogether to change it.

There is no principle in medicine so little understood, or so teeming with practical applications, as the apportioning the dose of a remedy to the object contemplated. Nor is there any error so fraught with evil consequences, as the impression that its activity or curative influence is in the ratio of the amount prescribed. The conditions which regulate its action, depend on the quantity which is allowed to be carried throughout the animal system, brought in contact with nervous matter, and the length of time it is permitted to remain undisturbed. It is, therefore, unquestionable, that a quantity, which, to ordinary practitioners would appear ridiculously small, will, where the latter of these conditions is scrupulously observed, effect important vital changes.

On what view are these changes explicable? The fact will scarcely be doubted. We have by repeated experiments tested its accuracy, and under circumstances so varied as to render incredulity an impossibility. The benefit which results is not difficult of explanation. It may be adduced as a striking illustration of the justness of the general principles and reasoning pervading these pages. On what can the minute dose of the remedy act, except upon the nervous system, except in modifying the conditions of the agent by which it is animated? Nor will its influence be confined to any particular portion of nervous matter. Small as the quantity may be, the entire of the nervous system will be brought within the range of its power. Certain parts only may display its effects from a peculiar susceptibility, or may arrest attention from falling more obviously under observation, but the general truthfulness of the axiom here laid down is indisputable. It is unequivocally corroborated by facts borrowed from other sources. The impalpable particles emanating from a flower, not seen, and altogether undetected by others, will, in one particularly sensitive, cause swooning or other phenomena. Medicinal matters floating in the atmosphere which is breathed, will produce results not less remarkable. The bite of a rabid animal, scarcely regarded from its insignificance, and perhaps soundly healed in the course of a few days, leaves a poison behind which slowly impregnates the entire of the nervous system, and at length shows itself in the most appalling of manifestations. It is not necessary to multiply these instances, others will readily occur to the mind of the reader.

CCCCLXXIII. Does no practical inference flow from these facts? Have they no application to the subject under consideration? Are we indeed to imagine that matters so impalpable to the senses, and capable of producing such extraordinary results, throw no light on the exquisite susceptibility of the nervous system? Is it philosophical to admit their influence in these cases, and at the same time to deny that remedies exceedingly attenuated in quantity, and undisturbed in their natural operations, are altogether inert?

CCCCLXXIV. The investigation of this subject offers a boundless field to the future inquirer. Every advance that is made in it will tend to elucidate the properties of the nervous system, its pervading influence in all vital actions, and will ultimately place in the hands of the practitioner means of far greater potency than any which he at present possesses. His improved position will enlarge his conceptions of the comprehensive relations which all local affections maintain with the diversified powers of life.

CCCCLXXV. It is now necessary to bring these labours to an end. They have occupied much time and patient thought. If they bear not the impress of either, the talents of the writer have been altogether unequal to the accomplishment of the task he proposed to himself. If it be urged as an objection, that his views are not practical, in the ordinary acceptation of the term, he at once admits it. His anxiety has not been to lay down the exact rules which should regulate the treatment of disease, or to illustrate its nature, modifications, or conditions under a variety of circumstances. His aim has been of a very different kind. It has been directed, as far as his humble abilities and concentrated energies would allow, to make known the properties of the nervous system,—to point out its relations to all parts of the animal economy, and to furnish a rational explanation of a large and interesting class of phenomena many of which have hitherto been unaccounted for and regarded as inexplicable. Let him be judged according to the objects he contemplated in these inquiries.

He contends that the first step towards the improvement of medical science, must begin with the study of the vital instruments on which and by which we have to act. We must first endeavour clearly to understand the springs and wheels which compose the living machine, and the way in which they variously co-operate in the production of their marvellous effects, before we presume to analyze or trace the character of their deviations from correct action, or attempt to adjust what is wrong. Any other course would be to reverse the natural order of things. Strongly impressed with the accuracy of these sentiments, the writer entered upon the present elaborate undertaking, and he leaves the determination of its value to the candid and enlightened mind.

THE END.

Thomas Harrild, Printer, Silver Street, Falcon Square, London.

Medical Works

BY

G. CALVERT HOLLAND, M.D.

LATELY PHYSICIAN TO THE SHEFFIELD GENERAL INFIRMARY, BACHELIER
ES-LETTRES OF THE UNIVERSITY OF PARIS, FORMERLY PRESIDENT OF
THE ROYAL PHYSICAL AND HUNTERIAN SOCIETIES, EDINBURGH.

I.

AN EXPERIMENTAL INQUIRY INTO THE LAWS OF LIFE.

PRICE 12s.

"Dr. Holland, in his Experimental Inquiry into the Laws of Life, has ably pointed out the fallacy of the conclusions of Wilson Philip, and others, with reference to the agency of the nervous system. He brings forward several interesting facts, and employs considerable ingenuity of reasoning to support his views, and to exhibit the importance of their application."—*Extracts from a work " On the Influence of Physical Agents on Life, by Mr. F. Edwards, M.D., F.R.S., translated from the French by Dr. Hodgkin and Dr. Fisher,* 1832.

"The chief merits of Dr. Holland's book we hold to consist in this, that without attempting to theorize on the ultimate causes of the actions of the body, it professes to reduce many of the phenomena of life to certain laws discoverable by observation; or, in other words, that he has applied the true Baconian method of philosophizing to physiology. Let him zealously task himself to tracing out the laws which regulate the actions of living beings, and we venture to predict that he will establish for himself a lasting reputation."—*The New Scots Magazine, No.* 8, 1829.

"This is a most ingenious, original, and very able work, on a subject of great importance not only to the physiologist, but also to the physician and society at large."—*Scotsman.*

"We regret that our limits do not allow us to notice the remaining chapters, the contents of which are at least as interesting as those which we have noticed. The work reflects great credit on the industry and research of the author."—*Lancet, August* 8, 1829

"We cannot do full justice to the many original speculations Dr. Holland enters into in reference to the laws which regulate the phenomena of organic and animal life."—*London Medical and Physical Journal.*

EDINBURGH: MACLACHLAN AND STEWART; AND SIMPKIN AND MARSHALL,
LONDON. 1829.

II.

THE PHYSIOLOGY

OF

THE FŒTUS, LIVER, AND SPLEEN.

PRICE 7s.

"In justice to Dr. Holland we must say, that he evinces on many occasions considerable ingenuity, a fair acquaintance with the rules of argument, and we think his criticism frequently alike just and shrewd."—*Medico-Chirurgical Review, July*, 1831.

"The work evinces much originality, extensive research, and powerful reasoning, and will be highly interesting to the physiologist. It will add to the well-earned reputation of the author. It is at once literary, scientific, and instructive, and well deserves a place with the first physiological productions of the day."—*The London Medical and Surgical Journal, April and May*, 1831.

III.

INQUIRY INTO THE PRINCIPLES & PRACTICE OF MEDICINE.

VOLUME I. PRICE 12s.

"It is well deserving the attention not only of the physiologist but of the physician; not only of the student but of the practitioner. Some of the principles stated in it are, to a considerable extent, new and sound; are expressed with clearness, and to many medical men the applications suggested must appear no less novel than they really are important."—*Monthly Repository*, 1833.

IV.

INQUIRY INTO THE PRINCIPLES & PRACTICE OF MEDICINE.

VOLUME II. PRICE 7s. 1835.

LONDON: LONGMAN, REES, ORME, AND CO.

V.

THE PHILOSOPHY OF THE MOVING POWERS OF THE BLOOD.

8vo. cloth. PRICE 8s.

"This work evinces much penetration, and is well worthy of consideration."—*Medico-Chirurgical Review.*

"We recommend Dr. Holland's work to the attention of such of our readers as wish to go more deeply into the question than they can do by means of the ordinary treatises on Physiology."—*British and Foreign Medical Review.*

VI.

DISEASES OF THE LUNGS

From Mechanical Causes:

AND

INQUIRIES INTO THE CONDITION OF THE ARTIZANS EXPOSED TO THE INHALATION OF DUST.

PRICE 4s.

"The treatise on the diseases of the lungs from mechanical causes is a production of considerable value, new in its facts, clear in its distinctions, sensible in its views, and cautious in its opinions. Considered only as a medical treatise, this part of the book would be entitled to high praise."—*Spectator, Jan.* 27, 1844.

"This is a book of sterling value, and presents special claims to the warm approbation of the medical reviewer. Unite to benevolent aims, good sense and high science, and you have Dr. Holland's book."—*The Medical Times, Jan.* 28, 1844

"Most valuable."—*London and Edinburgh Monthly Journal of Medical Science, February,* 1844.

"Dr. Holland is an able and experienced writer, whose name has long been familiar to the medical public. It was, therefore, with some curiosity that we opened his work on the mechanical causes of pulmonary disease, as we felt certain that a man of his great medical knowledge and sagacity, located as he has been in the very centre of one of our large manufacturing districts, could not fail to throw great light on the interesting point of hygiene and pathology, which he had undertaken to elucidate, nor were we disappointed in this respect. Dr. Holland's searching and elaborate account of the morbid and hygienic state of the workmen who are exposed to the inhalation of the metallic and petrous dust, created during their grinding operations, is the most complete and the most practical we have ever read. Dr. Holland's directions with regard to treatment are sound and practical."—*Lancet, February* 10, 1844.

LONDON:
PUBLISHED BY JOHN CHURCHILL, PRINCES STREET, SOHO.
1849.

VII.

PHILOSOPHY OF ANIMATED NATURE,

OR THE

Laws and Action of the Nervous System.

PRICE 12s.

"It exhibits considerable power of accurate observation in particular facts, and extensive acquirements in the more curious and refined, as well as in the professional parts of physiology. It exhibits a wide observation of physiological and mental phenomena, as well as some ingenious speculations on the connexion of mind and body."—*The Spectator, Sept.* 9, 1848.

"It is moderate in its tone and elaborate in its investigations: apart from the argument it is a production of much ability, and the experiments and deductions stated are of a very interesting and instructive order."—*The Literary Gazette, March* 4, 1848.

"Dr. Calvert Holland's work has more than ordinary claims to our attention. Whether the originality of the facts brought forward, the numerous interesting views which they elucidate, or the extensive knowledge exhibited of the labours of former philosophers, as well as of the laws of nature generally, be taken into account, it will be admitted to be a production of considerable value. We have evidence, in every page, of an active enterprising mind. Independently of the principles which it contains, it has literary qualities of a high order. The style is easy, elegant, and perspicuous; and not unfrequently we find in the volume passages of great eloquence and beauty. Dr. Calvert Holland is an original thinker. Everything that proceeds from his pen is entitled to our most patient and respectful consideration.

"No medical Work has appeared since the days of Harvey, displaying the same novel and comprehensive views; and certainly none having an equal claim to attention, from their extensive relations to the treatment of diseases. As we have already remarked, if the views be well founded, they will thoroughly change the prevailing doctrines, not only in reference to nervous affections, but to the complicated evils to which flesh is heir."—*The Journal of Physiological Medicine, and Mental Pathology, edited by Forbes Winslow, M.D., Oct.* 1, 1849.

"The work of Dr. Calvert Holland is throughout an original investigation, and one of an exceedingly high order, whether the novelty and comprehensiveness of its views be taken into account, the ingenuity with which they are supported, their importance if justly founded, or the correct and elegant literary taste which for the most part pervades its pages. We can conscientiously recommend the work, not only to the medical reader as one of considerable interest and value, but to the philosophical inquirer, whatever may be the nature of his pursuits. The originality and the perspicuity of its views, and the literary taste displayed in it, reflect great credit on the talents, research, and acquirements of Dr. Calvert Holland."—*The Medical Times, Sept.* 22, 1849.

LONDON:
PUBLISHED BY JOHN CHURCHILL, PRINCES STREET, SOHO.
1849.

VIII.

THE DISCOVERY

OF

THE USE OF THE HAIR,

In the Animal Economy.

PRICE 1s.

"We recommend Dr. Holland's pamphlet to the attention of our readers. Whether they accept or reject the views it developes, we are sure they will examine them with as much gratification as we have ourselves, for there is a freshness and a vigour about them which in these humdrum and unimaginative days, are quite refreshing."—*The Medical Times, April* 21, 1849.

"There is not a medical man in Great Britain who has devoted himself with greater zeal, nor whose labours have been attended with greater success in physiological inquiry, than Dr. Calvert Holland. His EXPERIMENTAL INQUIRY INTO THE LAWS OF LIFE laid the basis of a system in which the true Baconian method of philosophizing was first applied to physiology, a system from which instead of swerving in after years, he has ever since been bringing to a greater degree of perfection and maturity. "THE PHILOSOPHY OF ANIMATED NATURE, OR THE LAWS AND ACTION OF THE NERVOUS SYSTEM," attested the wide scope embraced by this new order of ideas, the truly important inquiries which it was capable of solving, and the wide field of research which it laid open. The great test of the soundness of any extensive generalizations, is always to be found in their applicability to the minutest details Dr. Holland has shown that his principles are sound, by his able theoretical work, "THE INQUIRY INTO THE PRINCIPLES AND PRACTICE OF MEDICINE;" his especial inquiry into "THE PHYSIOLOGY OF THE FŒTUS, LIVER AND SPLEEN," and by other monographs of the same kind. The new discovery to which the carrying out the same order of ideas has just led him, is, perhaps, the most novel and interesting of all. His comprehensiveness of the application of these views is most assuredly another favourable indication of their truthfulness; and we hope (although we scarcely dare believe it) that they will meet with at least a fair hearing from the established schools. Had they emanated from thence, their reception would have been certain, and honour and applause matters of course."—*The Literary Gazette, No* 1690. *London, June* 9, 1849.

LONDON:
H. BAILLIERE, 219, REGENT STREET;
WILLIAM HEADLAND, PRINCES STREET, HANOVER SQUARE.
1849.

LONDON:
THOMAS HARRILD, PRINTER, SILVER STREET,
FALCON SQUARE.